CDM

Libby Asbestos Site

Libby, Montana

Response Action Sampling and Analysis Plan, Revision 1

April 9, 2008

Sampling & Analysis Plan

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Libby Asbestos Site
Libby, Montana

Revision 1

April 9, 2008

Contract No. DTRT57-05-D-30109
Task Order No. 00012

U.S. Environmental Protection Agency
Region 8
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Acronyms and Abbreviations

A&E	architecture and engineering firm
AHERA	Asbestos Hazard Emergency Response Act
BNSF	Burlington Northern Santa Fe
CAR	*corrective action request*
CDM	CDM Federal Programs Corporation
COC	chain-of-custody
CFR	Code of Federal Regulations
CSHASP	comprehensive site health and safety plan
CSS	Contaminant Screening Study
DQOs	data quality objectives
EDD	electronic data deliverable
eLASTIC	Electronic Libby Asbestos Sample Tracking Information Center
EPA	U.S. Environmental Protection Agency
f/cc	fibers per cubic centimeter
FPM	field planning meeting
FSDS	field sample data sheet
FTL	field team leader
GPS	global positioning system
HASP	health and safety plan
HEPA	high-efficiency particulate air
ID	identification
IDW	investigation-derived waste
KDC	Kootenai Development Corporation
LA	Libby amphibole asbestos
L/min	liters per minute
MCE	mixed cellulose ester
mm	millimeter
NPE	negative-pressure enclosure
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OU	operable unit
PCM	phase contrast microscopy
PDI	pre-design inspection
PLM	polarized light microscopy
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RAWP	Response Action Work Plan
S/cc	structures per cubic centimeter
SAP	sampling and analysis plan
SOP	standard operating procedure
SRC	Syracuse Research Corporation
STEL	short-term exposure limit
SUA	specific-use area
SWQAPP	site-wide quality assurance project plan
TEM	transmission electron microscopy

TL	task leader
TWA	time-weighted average
VCI	vermiculite-containing insulation
Volpe Center	John A. Volpe National Transportation Systems Center
W.R. Grace	W.R. Grace Company
Zonolite	Universal Zonolite Insulation Company
µm	micrometer

Section 1
Introduction

This document serves as the response action sampling and analysis plan (SAP) for the ongoing cleanup efforts being conducted under the response action work plan (RAWP) (CDM Federal Programs Corporation [CDM] 2008a) at the Libby Asbestos Site under the U.S. Department of Transportation, John A. Volpe National Transportation Systems Center (Volpe Center) Contract. The Volpe Center is serving as the contracting authority for the U.S. Environmental Protection Agency (EPA), Region 8 for response actions currently being conducted in Libby, while CDM is serving as the architecture and engineering firm (A&E) under the Volpe Center contract. This SAP outlines the sampling and analysis to be conducted to support response actions (i.e., removal activities) described in the RAWP. These activities include personal and stationary air monitoring, clearance air sampling, and visual inspections for vermiculite combined with confirmation soil sampling.

This SAP contains all the elements required for both a field sampling plan and quality assurance (QA) project plan. This SAP was developed in accordance with the *Environmental Protection Agency Requirements for Quality Assurance Project Plans, EPA QA/R-5* (EPA 2001), and the *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G4* (EPA 2006). This SAP also incorporates certain requirements as specified in the Site-wide QAPP (SWQAPP) for the Libby Asbestos Project (CDM 2007a).

The purpose of this SAP is to describe the sampling objectives, locations, measurement methods, and data quality objectives (DQOs) for residential, commercial, and industrial response actions. The SAP is organized as follows:

Section 1 - Introduction
Section 2 – Site Background
Section 3 – Data Quality Objectives
Section 4 – Sampling Program
Section 5 – Laboratory Operations
Section 6 – Assessment and Oversight
Section 7 – Data Review and Verification
Section 8 – References

1.1 Objectives

This section defines the objectives of the response action sampling program and the intended use of data.

As determined by previous investigations conducted at the Libby Superfund Site, Libby amphibole asbestos (LA) is present in multiple environmental media in Libby including: indoor air, outdoor ambient air, indoor dust, vermiculite insulation, and soils. As a result, residents of Libby may be exposed to LA, and these exposures may pose a risk of cancer and/or non-cancer adverse health effects.

Since 2001, EPA has been performing response actions to remove LA-contaminated media (i.e., soil, insulation, interior dust) at residential, commercial, and industrial properties. The objective of the sampling program described in this SAP is to collect data of sufficient quality and representativeness to ensure LA-contaminated media is removed to meet current EPA cleanup criteria and goals (EPA 2003).

1.2 Project Schedule and Deliverables

Based on data collected during EPA's site-wide contaminant screening study (CSS), approximately 1,600 properties require a response action as a result of LA contamination. These response actions could include interior removal, exterior removal, or both. The number of properties requiring a response action may increase depending on ongoing risk assessment findings or the development of improved analytical technologies. Currently, over 900 properties have undergone response actions that meet cleanup goals as defined in EPA's Action Level/Clearance Criteria Technical Memorandum (EPA 2003). Depending on project funding, contracting, and yearly project goals, it is anticipated that response actions will continue in Libby through 2012. Most remaining properties that require response actions have exterior contamination. Therefore, future annual removal schedules will be set, in part, based on seasonal and weather considerations.

Section 2
Site Background

This section describes site location and history.

2.1 Site Location

The Libby asbestos site is located within Sections 3 and 10, T30N, R31W of the Libby Quadrangle in Lincoln County, Montana (Figure 2-1). The site includes homes and other businesses, which may have become contaminated with asbestos fibers as a result of the vermiculite mining and processing conducted in and around the City of Libby (Figure 2-2).

The Libby Superfund Site has been subdivided into seven OUs to facilitate a phased approach to cleanup (Figure 2-3):

- OU1. The former export plant is defined geographically by the property boundary of the parcel of land that included the former export plant.

- OU2. The exact geographic area of OU2 has not yet been defined, but includes areas impacted by contamination released from the former screening plant. These areas include the former screening plant, the Flyway property, the Highway 37 right-of-way adjacent to the former screening plant and/or Rainy Creek Road, the Wise property, and the Kootenai Development Corporation (KDC) Bluffs. The KDC Bluffs area is located directly across the Kootenai River from the former screening plant.

- OU3. The mine OU includes the former vermiculite mine and the geographic area (including ponds) surrounding the former vermiculite mine that has been impacted by releases from the mine, including Rainy Creek and the Kootenai River. Rainy Creek Road is also included in OU3. The exact geographic area of OU3 has not yet been defined but will be based primarily upon the extent of contamination associated with releases from the former vermiculite mine.

- OU4. OU4 is defined as residential, commercial, industrial (not associated with former W.R. Grace operations), and public properties, including schools and parks in and around the City of Libby, or those which have received material from the mine not associated with W.R. Grace operations. Highway transportation corridors such as Highway 37 (including the 5 miles of Highway 37 beginning at the intersection of Rainy Creek Road and extending into the town of Libby) are also included in OU4. Portions of Highway 37 associated with the screening plant are addressed in OU2 and are therefore excluded from OU4.

- OU5. The former Stimson Lumber Mill is defined geographically by the parcel of land that included the former Stimson Mill.

- OU6. The rail yard owned and operated by the Burlington Northern and Santa Fe Railroad (BNSF) is defined geographically by the BNSF property boundaries and extent of contamination associated with the rail yard. Railroad transportation corridors are also included in this OU. The eastern and western boundaries of this OU have not yet been defined.

- OU7. The Troy OU includes all residential, commercial, and public properties within the town of Troy.

2.2 Site History

Vermiculite was discovered 7 miles northeast of Libby, Montana in 1881 by gold miners. In the early 1920s, Mr. Edward Alley began initial mining operations on the vermiculite ore body located approximately 7 miles northeast of Libby. Full-scale operations began later that decade under the name of the Universal Zonolite Insulation Company (Zonolite). This ore body contains a solid solution series of amphibole asbestos fibers with compositions including tremolite, actinolite, richterite, and winchite (herein referred to as LA) as defined by B.E. Leake *et al.* (1997). Unlike chrysotile asbestos, LA has never been used commercially on a wide scale. During the mine's operating life, while vermiculite was used in a variety of products (including insulation and construction materials, as a carrier for fertilizer and other agricultural chemicals, and as a soil conditioner), LA was considered a byproduct of little or no value.

The vermiculite ore was mined using standard strip mining techniques and conventional mining equipment. The ore was then processed in an onsite dry mill to remove waste rock and overburden material. Once processed, the ore was transported from the mine to the former screening plant, where the ore was sorted into five size ranges. After the sorting process, the material was shipped to various locations across the United States, for either direct inclusion in products or for "expansion" prior to use in products. Expansion (also known as "exfoliation" or "popping") was accomplished by heating the ore, usually in a dry kiln, to approximately 2,000 degrees Fahrenheit. This process explosively vaporizes the water contained within the phyllosilicate structure causing the vermiculite to expand by a factor of 10 to 15. This produces the vermiculite material most commonly sold as a soil amendment for gardens and greenhouses.

In Libby, operations handling this material occurred at four main locations: the mine and mill located on Rainy Creek Road on top of Zonolite Mountain; the former screening plant and railroad loading station located at the intersection of Highway 37 and Rainy Creek Road and directly across the Kootenai River, respectively; the former expansion/export plant (the former export plant) located immediately west of Highway 37 where it crosses the Kootenai River; and at the former expansion plant located at the end of Lincoln Road, near 5th Street. The Lincoln Road Expansion Plant went offline sometime in the early 1950s.

In 1963, the W.R. Grace Company (W.R. Grace) purchased Zonolite and continued vermiculite mining operations in a similar fashion. In 1975, a wet milling process was added that operated in tandem with the dry mill until the dry mill was taken offline in 1985. The wet milling process was added to reduce dust generation of the milling process. Expansion operations at the former export plant ceased in Libby sometime prior to 1981, although this area was still used to bag and export milled ore until mining operations were stopped in 1990. Before the mine closed in 1990, Libby produced about 80 percent of the world's supply of vermiculite.

Since 1999, EPA Region 8 has been conducting sampling and cleanup activities to address highly contaminated areas in the Libby Valley. The EPA inspection was initiated in response to media articles, which detailed extensive asbestos-related health problems in the Libby population. While at first the situation was thought limited to those with direct or indirect occupational exposures, it soon became clear that there were multiple exposure pathways and many persons with no link to mining-related activities were affected.

2.3 Occurrence of LA

Typically, the LA contamination found in the Libby Valley comes from one or some combination of "primary" sources: vermiculite mining wastes, vermiculite ores, vermiculite processing wastes, bulk residuals from vermiculite processing, "LA-containing rocks," or LA-containing vermiculite attic insulation. Asbestos from these primary sources has been found in interior building dust samples and local soils, which in turn act as secondary sources. To date, EPA's goal has been to find and identify areas with elevated levels of LA (the primary sources) and to remove them. EPA has conducted removal of contaminated soil at the former export plant location, the former screening plant and adjacent properties, and residential properties with LA source materials present. Removal actions have also been performed at three schools in Libby.

Cleanup work in Libby is ongoing and includes the removal of LA-containing media that include: vermiculite-containing insulation (VCI), soil, and dust from residential, commercial, and industrial properties. The VCI encountered in structures is typically found in attics and exterior walls where it is used for insulation. In some cases, VCI is found in interior and exterior walls due to sifting from the attic. The LA-contaminated soil encountered is generally due to vermiculite used as a soil amendment in flowerbeds and gardens, leveling of low spots, and backfilling of utilities. LA-contaminated dust occurs inside structures due to VCI leaking into the living spaces from the attic or walls, and LA tracked inside from the outdoor source locations discussed above.

2.4 Removal Contractors

Contaminated soil, VCI removal and interior cleaning (i.e., dust removal) will be performed based upon EPA or Volpe Center task orders and all approved plans. A variety of contractors will be utilized to complete the response actions for the Libby

site, including removal contractors and contractors for providing fill materials, landscape restoration, laboratory analysis, security, and surveying.

Section 3
Data Quality Objectives

The DQO process, based on scientific methods, is a series of planning steps that are designed to ensure that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended purpose. The DQOs presented in this section were developed in accordance with EPA guidance (EPA 2006a).

The DQO process specifies project decisions, the data quality required to support those decisions, specific data types needed, data collection requirements, and analytical techniques necessary to generate the specified data quality. The process also ensures that the resources required to generate the data are justified. The DQO process consists of seven steps; output from each step influences the choices that will be made later in the process. These steps include:

1. State the problem
2. Identify the decision
3. Identify the inputs to the decision
4. Define the study boundaries
5. Develop a decision rule
6. Specify tolerable limits on decision errors
7. Optimize the design

3.1 Step 1 – State the Problem

The purpose of this step is to describe the problem to be studied so that the focus of the investigation will be unambiguous.

Previous studies such as the CSS and Pre-Design Inspections (PDIs) were designed to determine the nature and extent of LA source materials at residential and commercial properties in and around Libby. Based on findings of CSS and PDI investigations, removal activities are performed at residential and commercial properties found to contain VCI, LA asbestos-contaminated interior dust, and/or exterior soils.

During removal activities on those properties (e.g., excavation of contaminated soil), the potential for LA fibers to migrate offsite increases. Likewise, during these activities, the potential for LA exposure to workers is also increased. Therefore, it is important to monitor worker exposure and fugitive dust engineering controls. This is accomplished through a systematic response action air sampling program. In addition, confirmation and/or clearance samples must be collected to determine if the response actions met project-specific goals. Therefore, the overall response action sampling program must address:

- Worker exposure to nuisance dust and LA
- Effectiveness of equipment-use practices and engineering controls during removal activities
- Achievement of the cleanup goals following removal activities

This SAP describes the sampling and inspection procedures that will be used to collect data of sufficient quality and representativeness to evaluate each of these items.

3.2 Step 2 - Identify the Decision

This step identifies what questions the investigation will attempt to resolve and what actions may result. The principle study questions and possible alternative actions are as follows:

Response Item Evaluated	Principle Study Question	Alternative Actions
Worker exposure to nuisance dust and LA	Are fibers detected in the workers' breathing zone above worker safety limits?	▪ Evaluate and re-train employees on work practices that reduce dust emissions and re-sample ▪ Take no action
Effectiveness of equipment-use practices and engineering controls during removal activities	Are LA structures in ambient air migrating beyond the exclusion zone boundary during LA-contaminated soil removal activities?	▪ Evaluate engineering controls and work practices ▪ Take no action
	Are LA structures detected in ambient or exhaust air of equipment utilized by the removal contractor?	▪ Inspect equipment HEPA filters (if equipped), replace as necessary, and re-sample ▪ Perform thorough wet-wiping of sampled area (e.g., decontamination trailer clean room); re-train personnel on good housekeeping practices, and re-sample ▪ Take no action
Achievement of the cleanup goals following removal activities	Are LA structures detected in the air within a NPE where VCI was removed?	▪ Re-encapsulate, re-clean, and re-sample NPE ▪ Take no action
	Are LA structures detected in the air within an NPE where LA-contaminated dust was removed?	▪ Re-clean and re-sample NPE ▪ Take no action
	Is LA detected in the soil of the floor of an excavated area?	▪ Excavate additional soils ▪ Take no action
	Are high levels of vermiculite visible in the soil of the floor of an excavated area?	▪ Excavate additional soils ▪ Take no action

LA – Libby amphibole asbestos
HEPA – high-efficiency particulate air
NPE – negative pressure enclosure

3.3 Step 3 - Identify the Inputs to the Decision

The purpose of this step is to identify the information and measurements that need to be obtained to resolve the decision statements. The information needed to resolve the principal study questions are summarized in Table 3-1.

This RAWP SAP is designed only for cleanups for which LA characterization at a property (e.g., soil concentration, indoor dust levels, etc.) has been performed through another SAP (e.g., Pre-Design Inspection Activities Work Plan).

3.4 Step 4 - Define the Boundaries of the Study

This step specifies the spatial and temporal boundaries of this investigation.

3.4.1 Spatial Bounds

The information gathered to answer the objectives will be collected from residential and commercial properties within the boundaries of the Libby Superfund Site (Figure 2-2). The vertical spatial boundaries extend from the highest point in a residential or commercial property, approximately two stories, to the deepest excavation completed, approximately 3-feet below ground surface.

3.4.2 Temporal Bounds

The temporal boundaries of this investigation include the time from when response actions begin at each property to the time clearance or confirmation samples are collected and meet project-specific clearance criteria.

3.5 Step 5 - Develop Decision Rules

The purpose of this step is to describe the method that EPA will use to determine if the data collected indicate acceptance and the resulting decision applied when acceptance is not obtained. The data will also be used to determine if additional removal actions are warranted under the current removal criteria (EPA 2003). The principal study question, inputs to resolve study questions, action levels, and decision rules are summarized in Table 3-2.

3.6 Step 6 - Specify Tolerable Limits on Decision Errors

The tolerable limits on decision errors, used to establish performance goals for the data collection design, are specified in this step.

Specific to the collection of response action clearance air and confirmation soil samples, two types of decision errors are possible:

- A Type I (false negative) decision error would occur if a risk manager decides that the sample does not contain LA above a level of concern, when in fact it is of concern.
- A Type II (false positive) decision error would occur if a risk manager decides that levels of LA in samples are above a level of concern, when in fact it is not.

EPA is most concerned about guarding against the occurrence of Type I errors, since an error of this type may leave humans exposed to unacceptable levels of LA.

EPA is also concerned with the probability of making Type II (false positive) decision errors. Although this type of decision error does not result in unacceptable human exposure, it may result in unnecessary expenditure of resources. Generally, EPA allows for a 20 percent false positive rate.

For the purposes of completing all six steps of the DQO process, the null hypotheses and consequences of making an incorrect decision are summarized in Table 3-3. However, the gray region and tolerable limits on decision errors are not proposed because they are not applicable in this case.

Typically, Step 6 of the DQO process is useful to encourage careful design of decision rules by defining and integrating the errors that are acceptable based upon a myriad of integrated project management decisions such as reduction in risk to human health, implementability/practability, and cost. As stated in the guidance document for development of DQOs: QA/G-4 (EPA 2006a), solely statistically generated tolerable limits on decisions errors are not necessary in certain cases providing a line of reasoning (scientific justification) is presented that adequately defines acceptable limits or decision errors. This particular effort was put forth in the Action Level/Clearance Criteria Technical Memorandum (EPA 2003) for the following DQOs: (1) Soil Confirmation Samples; (2) Perimeter Monitoring Air Samples; (3) Air Clearance for VCI Removal; and (4) Air Clearance for Indoor Dust Removal. The decision rule for the personal breathing zone air monitoring samples has been promulgated by legislation, and as such, limits on decision errors do not apply.

3.7 Step 7 – Optimize the Design for Obtaining Data

This step identifies a resource-effective data collection design for generating data that are expected to satisfy the DQOs. The data collection design is described in detail in the remaining sections of this SAP and other site documents referenced in Section 4.

Using data previously generated for the site, the DQOs have been designed to support the proposed response activities under the RAWP (CDM 2008a) and represent the best possible project planning effort. However, in implementing the requirements contained in this SAP, unforeseen situations may arise or team members may find more efficient means to carry out some of the day-to-day activities. Therefore, team members are always afforded the opportunity to recommend optimization of the data gathering design. Recommendations must come through proper channels (i.e., through the task leader [TL] or field team leader [FTL]) and documented using either a Libby Asbestos Project Record of Modification Form (provided in Appendix D) or an addendum to this SAP. All modifications or addendums must be approved prior to making the proposed changes.

Table 3-1 Summary of Inputs to Resolve Study Questions and Use of Information Acquired from Inputs

Principle Study Question	Input to Resolve Question	Use of Input to Resolve Question
Are LA structures in ambient air migrating beyond the exclusion zone boundary during LA-contaminated soil removal activities?	Perimeter Air Samples	For each property undergoing exterior response actions, stationary air samples will be collected from the perimeter of the exclusion zone downwind of soil removal activities. The perimeter air sample will be used to determine if the removal contractor is employing adequate engineering controls and work practices during removal activities to minimize LA migration outside the exclusion zone.
Are LA structures detected in the air within an NPE where VCI was removed?	Attic Clearance Air Samples	For each property undergoing VCI removal, stationary clearance air samples will be collected from within the NPE where the VCI was removed. The results of the clearance air samples will be used to determine if LA contamination was removed to project-specific clearance criteria.
Are LA structures detected in the air within an NPE where LA-contaminated dust was removed?	Living Space Clearance Air Samples	For each property undergoing LA-contaminated dust removal, stationary clearance air samples will be collected from within the NPE where the contaminated dust was removed. The results of the clearance air samples will be used to determine if LA contamination was removed to project-specific clearance criteria.
Are LA structures detected in ambient or exhaust air of equipment utilized by the removal contractor?	Equipment Air Monitoring Samples	For each property undergoing response actions, stationary air samples will be collected from the exhaust air of equipment (e.g., industrial vacuums, negative air machines, etc.) used by the removal contractor (if applicable). Additionally, stationary air samples will be collected from the clean room of the decontamination trailer (if applicable). The stationary air sample results will be used to determine if the removal contractor is maintaining the equipment properly and employing good housekeeping practices for their equipment.
Are fibers detected in the workers' breathing zone above worker safety limits?	Personal Air Samples	Personal air samples will be collected from the removal contractor workers during removal activities performing specific tasks (e.g., equipment operator, laborer, bulk removal, etc.). The personal air samples will be used to monitor removal contractor work practices, determine if respiratory protection is adequate for the task being conducted, and ensure compliance with OSHA regulatory standards.
Is LA detected in the soil of the floor of an excavated area?	Confirmation Soil Samples	For each property undergoing LA-contaminated soil removal, confirmation soil samples will be collected from the floor of the excavated area. The results of the confirmation soil samples will be used to determine if LA contamination was removed to project-specific clearance criteria.
Are high quantities of vermiculite visible in the soil of the floor of an excavated area?	Confirmation Soil Samples	For each property undergoing LA-contaminated soil removal, a semi-qualitative visual estimation of vermiculite will be performed for the floor of the excavated area. The results of the visual inspection will be used to determine if vermiculite was removed to project-specific clearance criteria.

LA – Libby Amphibole
NPE – negative pressure enclosure
OSHA – Occupational Safety and Health Administration
VCI – vermiculite-containing insulation

Table 3-2 Decision Rules

Principle Study Question	Input to Resolve Question	Input Requirements	Action Level	Decision Rule
Are LA structures in ambient air migrating beyond the exclusion zone boundary during LA-contaminated soil removal activities?	Perimeter Air Samples	Analysis: TEM AHERA with site-specific modifications AS[1]: ~0.005 S/cc Minimum Volume: 1200 L/sample Collect: 1 sample along exclusion zone downwind of excavation	≥ 2 LA structures on one perimeter air sample	If samples are overloaded or LA structures are above the desired level, then engineering controls and work practices will be evaluated by the A&E and presented to the onsite Volpe Center representative. If LA structures are not detected, take no action.
Are LA structures detected in the air within a NPE where VCI was removed?	Attic Clearance Air Samples	Analysis: TEM AHERA with site-specific modifications AS: 0.005 S/cc Minimum Volume: 1200 L/sample Collect: 5 samples of disturbed air within NPE	≤ 5 LA structures over 5 attic clearance air samples	Following VCI removal activities, if the air in the NPE contains LA structures above the desired level or samples are overloaded, then the area will be re-cleaned by the removal contractor and re-sampled by the A&E. If LA structure counts are below the desired level, then the area is acceptably cleaned.
Are LA structures detected in the air within an NPE where LA-contaminated dust was removed?	Living Space Clearance Air Samples	Analysis: TEM AHERA with site-specific modifications AS: 0.005 S/cc Minimum Volume: 1200 L/sample Collect: 5 samples of disturbed air within NPE	0 LA structures over 5 living space clearance air samples	Following LA-contaminated indoor dust removal activities, if the air in the NPE contains LA structure counts above the desired level or samples are overloaded, then the area will be re-cleaned by the removal contractor and re-sampled by the A&E. If LA structures are below the desired level, then the area is acceptably cleaned.
Are LA structures detected in ambient or exhaust air of equipment utilized by the removal contractor?	Equipment Air Monitoring Samples	Analysis: TEM AHERA with site-specific modifications AS[1]: ~0.005 S/cc Minimum Volume: 1200 L/sample Collect: 1 sample within decontamination trailer clean room; 1 sample of equipment exhaust air	0 LA structures on one equipment air monitoring sample	If LA structure counts in ambient air are above the desired level or samples are overloaded, then the equipment (e.g., decontamination trailer clean room) will be thoroughly wet-wiped by the removal contractor; removal contractor personnel will be retrained on good housekeeping practices by their supervisor(s); and the ambient air re-sampled by the A&E. If LA structure counts in exhaust air are above the desired level or samples are overloaded, then the equipment will be inspected by the A&E, HEPA filters replaced (if applicable) by the removal contractor, and the exhaust air re-sampled by the A&E. If LA structures are not detected, take no action.

Table 3-2 Decision Rules

Principle Study Question	Input to Resolve Question	Input Requirements	Action Level	Decision Rule
Are fibers detected in the workers' breathing zone above worker safety limits?	Personal Air Samples	Analysis: PCM by NIOSH 7400; TEM AHERA with site-specific modifications AS_{PCM}: 1 f/cc AS^{1}_{TEM}: ~0.005 S/cc Minimum Volume: 25 L/sample Collect: 8-hour TWA; 30-minute STEL excursion sample	TWA: 0.1 PCME f/cc STEL: 1.0 f/cc	If fibers are detected in the workers' breathing zone above the worker safety limits or samples are overloaded, engineering controls, work practices, and/or PPE will be evaluated by the A&E and presented to the onsite Volpe Center representative. In addition, the sample will be analyzed by TEM AHERA for confirmation of LA for informational purposes only. If fibers are detected below the worker safety limits, take no action.
Is LA detected in the soil of the floor of an excavated area?	Confirmation Soil Samples	Analysis: PLM by NIOSH 9002 Reported Result: % LA by VAE AS: Method defined as 1%, but qualitative estimates of LA present below 1% reported as <1% or ND Approximate Sample Mass: 1 kilogram	Less than the excavation depth defined in the site-specific removal work plan: any detectable LA Equal to or greater than the excavation depth as defined in the site-specific removal work plan: ≥1% LA	If, at less than the excavation depth defined in the site-specific removal work plan, LA is detected in confirmation soil samples, then excavation will advance to the specified depth. If, at depths equal to or greater than the excavation depth defined in the site-specific removal work plan, LA is detected in confirmation soil samples, then excavation will advance in 6-inch increments to a maximum depth of 3 feet below ground surface. This iterative sampling process will occur after each 6-inch increment has been removed until desired levels are achieved. If LA in soil is below desired levels, then the area is acceptably cleaned.
Are high quantities of vermiculite visible in the soil of the floor of an excavated area?	Confirmation Soil Samples	CDM-LIBBY-13, Revision 0	High quantities of visible vermiculite as defined in CDM-LIBBY-13, Revision 0	If high quantities of vermiculite are observed in soil of the floor of the excavation, then excavation will advance in 6-inch increments to a maximum depth of 3 feet below ground surface. This iterative semi-qualitative evaluation process will occur after each 6-inch increment has been removed until desired levels are achieved. If no, low, or intermediate quantities of vermiculite are observed in the soil of the floor of the excavation, then the area is acceptably cleaned.

AHERA – Asbestos Hazard Emergency Response Act
AS – analytical sensitivity
cc – cubic centimeters
L – liters
% – percent
NIOSH – National Institute for Occupational Safety and Health
NPE – negative pressure enclosure
PCM(E) – phase contrast microscopy (equivalent)
PPE – personal protective equipment
S – structures
STEL – short-term exposure limit
TEM – transmission electron microscopy
TWA – time weighted average
VAE – visual area estimation

[1] The laboratory will attempt to achieve the method analytical sensitivity of 0.005 S/cc using direct sample preparation techniques and will employ project-specific stopping rules as documented in Laboratory Modification #LB-000017

Table 3-3 Limits on Decision Errors

Principle Study Question	Null Hypothesis	Type I Error Will Result In:	Type II Error Will Result In:
Are LA structures in ambient air migrating beyond the exclusion zone boundary during contaminated soil removal activities?	The perimeter air is contaminated with LA.	Determining that the perimeter air is not contaminated with LA when it actually is. This in turn, results in an increased risk to human health.	Determining that the perimeter air is contaminated with LA when it is not. This in turn, results in re-evaluating engineering controls and possibly stopping work when it is not necessary, and adds unnecessarily to cleanup costs.
Are LA structures detected in the air within an NPE where VCI was removed?	The NPE (attic) that contained VCI prior to removal is still contaminated with LA after removal.	Determining that the NPE that previously contained VCI is not contaminated with LA after removal when it actually is. This in turn, results in an increased risk to human health.	Determining that the NPE that previously contained VCI is contaminated with LA after removal when it is not. This in turn, results in unnecessary re-cleaning of the NPE and adds unnecessarily to cleanup costs.
Are LA structures detected in the air within an NPE where LA-contaminated dust was removed?	The NPE (living space) that was previously contaminated with LA is still contaminated with LA after removal.	Determining that the NPE that was previously contained LA-laden dust is not contaminated with LA after removal when it actually is. This in turn, results in an increased risk to human health.	Determining that the NPE that previously contained LA-laden dust is contaminated with LA after removal when it is not. This in turn, results in unnecessary re-cleaning of the NPE and adds unnecessarily to cleanup costs.
Are LA structures detected in ambient or exhaust air of equipment utilized by the removal contractor?	The ambient air is contaminated with LA as a result of equipment being used by the removal contractor.	Determining that the ambient air is not contaminated with LA when it actually is. This in turn, results in an increased risk to human health.	Determining that the ambient air is contaminated with LA when it is not. This in turn, results in unnecessary maintenance, evaluation of engineering controls, and possibly stopping work when it is not necessary, and adds unnecessarily to cleanup costs.
Are fibers detected in the workers' breathing zone above worker safety limits?	The breathing zone air is contaminated with nuisance dust and/or LA above the worker safety action levels.	Determining that the breathing zone air is not contaminated with fibers and/or LA above the worker safety action levels when it actually is. This in turn, results in an increased risk to workers performing removal actions.	Determining that the breathing zone air is contaminated with nuisance dust and/or LA above the worker safety action levels when it is not. This in turn, results in re-evaluating engineering controls, possibly stopping work, or increasing the level of PPE when it is not necessary and adds unnecessarily to cleanup costs.
Is LA detected in the soil of the floor of an excavated area?	The soils below an excavation are still contaminated with LA after removal.	Determining that the surface soils at the bottom of the excavated area are not contaminated with LA when they actually are. This in turn, results in an increased risk to human health.	Determining that the surface soils at the bottom of the excavated area are contaminated with LA when they are not. This in turn, results in excavation of additional soils when it is not necessary and adds unnecessarily to cleanup costs.
Are high quantities of vermiculite visible in the soil of the floor of an excavated area?	The soils below an excavation still contain high quantities of vermiculite	Determining that the surface soils at the bottom of the excavated area do not contain high quantities of vermiculite when they actually are. This in turn, results in an increased risk to human health.	Determining that the surface soils at the bottom of the excavated area do contain high quantities of vermiculite when they do not. This in turn, results in excavation of additional soils when it is not necessary and adds unnecessarily to cleanup costs

NPE – negative pressure enclosure PPE – personal protective equipment RA – removal action

Section 4
Sampling Program

This section summarizes field activities that will be performed by the A&E in support of Libby response actions. This section also provides brief summaries of standard operating procedures (SOPs), including project-specific modifications where applicable and project-specific details not discussed in the SOPs. For comprehensive information, field personnel will refer to the general and project-specific SOPs included in Appendix A. The Comprehensive Site Health and Safety Plan (CSHASP) (CDM 2006) and the A&E's site-specific health and safety plan (CDM 2008b) should be consulted to determine health and safety protocols for performing site work.

All sampling activities will be performed in accordance with this SAP. The SOPs and project-specific procedures to be employed are as follows:

- Sample Custody (Modified CDM SOP 1-2)
- Packaging and Shipping of Environmental Samples (Modified CDM SOP 2-1)
- Guide to Handling of Investigation-Derived Waste (IDW) (Modified CDM SOP 2-2)
- Field Logbook Content and Control (Modified CDM SOP 4-1)
- Field Equipment Decontamination at Non-radioactive Sites (Modified CDM SOP 4-5)
- Control of Measurement and Test Equipment (CDM SOP 5-1)
- Project-specific SOP for Completion of Field Sample Data Sheets (FSDSs) (CDM-LIBBY-03)
- Project-specific SOP for Global Positioning System (GPS) Coordinate Collection and Handling (CDM-LIBBY-09)
- Project-specific SOP for Stationary Air Sample Collection (CDM-LIBBY-14)
- Project-specific SOP for Confirmation Soil Sample Collection (CDM-LIBBY-13)
- Project-specific SOP for eLASTIC (Electronic Libby Asbestos Sample Tracking Information Center) for completion of electronic COC forms (CDM-LIBBY-11)

The following sections are a summary of field activities that will be performed during the performance of the sampling investigation efforts described in this SAP.

Analytical methods for all samples collected in accordance with this SAP are discussed in detail in Section 5.

4.1 Pre-Sampling Activities

Prior to beginning of field activities, a field planning meeting will be conducted, any required trainings will be performed, and an inventory of equipment and supplies will be completed to determine procurement needs.

4.1.1 Field Planning Meeting

Prior to beginning field activities, a field planning meeting (FPM) will be conducted by the A&E's removal oversight TL or FTL, which will be attended by the field team members conducting the work, a member of the A&E's QA staff, and a member of the A&E's health and safety staff. The agenda, prepared by the TL or FTL, will be reviewed and approved by QA and health and safety staff prior to the FPM. A field planning meeting agenda is provided in Appendix B. The FPM will briefly discuss and clarify:

- Documents governing fieldwork that must be on site
- Any changes in the governing documents
- Objectives and scope of the fieldwork
- Equipment and training needs
- Field operating procedures, schedule of events, and individual assignments
- Required quality control (QC) measures
- Health and safety requirements

During the FPM, copies of the agenda will be distributed and an attendance list will be circulated for signature. The agenda and the completed attendance list will be maintained in the project files, located in the A&E's Denver, Colorado office. Additional meetings will be held when major changes to the documents governing fieldwork occur, or when the scope of the assignment changes significantly.

Field team members will perform the following activities before and during field activities, as applicable:

- Review and understand applicable governing documents
- Record appropriate levels of documentation regarding activities conducted
- Ensure coordination between key staff, such as the A&E's sample coordinator and the removal contractor
- Ensure that all sample analyses are scheduled through the laboratory
- Obtain required sample containers and other supplies

- Obtain, check, and calibrate field sampling equipment
- Obtain and maintain personal protective equipment (PPE)

4.1.2 Field Team Training Requirements

Prior to starting work described in this document, any new field team member must complete the following, at a minimum:

- Read the CSHASP (CDM 2006) and site-specific HASP (CDM 2008b) – completion of this requirement will be documented on the respective health and safety plan signature sheet (maintained by the A&E's onsite health and safety officer) and investigation-specific required reading report (maintained by the A&E's removal oversight TL or FTL)
- Attend an orientation session with the A&E's onsite health and safety officer – completion of this requirement will be documented on an orientation session attendance sheet (maintained by the A&E's onsite health and safety officer)
- Read and understand all relevant governing documents – completion of this requirement will be documented on an investigation-specific required reading report (maintained by the A&E's removal oversight TL or FTL)
- Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Operations and Emergency Response certification and relevant 8-hour refresher course certifications – completion of this requirement will be documented by training certificates (maintained by the A&E's onsite health and safety officer)
- Respiratory protection course certification as required by 29 Code of Federal Regulations (CFR) 1910.134 – completion of this requirement will be documented by training certificate (maintained by the A&E's onsite health and safety officer)
- Asbestos awareness course certification as required by 29 CFR 1910.1001 – completion of this requirement will be documented by training certificate (maintained by the A&E's onsite health and safety officer)
- Sample collection techniques – completion of this requirement will be documented on training session attendance sheets (maintained by the A&E's removal oversight TL or FTL)
- Identification of vermiculite and Libby mine related materials – completion of this requirement will be documented on training session attendance sheets (maintained by the A&E's removal oversight TL or FTL)

Documentation of trainings/certifications will be stored in the Libby project files located at the A&E's Denver office.

4.1.3 Inventory and Procurement of Equipment and Supplies

The following equipment is required for sampling activities conducted under this SAP. Any required equipment not already contained in the field equipment supply inventory will be procured prior to initiation of sampling activities and acceptance verified according to CDM SOP 5-1, when applicable:

- Field logbooks
- Indelible ink pens
- Digital camera with memory card, as appropriate
- Rotameter
- High-volume (electric powered) and low-volume (battery powered) air sampling pumps
- Air sample media: 25 millimeter (mm) diameter mixed cellulose ester (MCE) filter cassettes with 0.8 micrometer (µm) filter pore size
- Sample paperwork and sample tags/labels
- Custody seals
- Plastic zip-top bags
- Soil sampling equipment
- GPS unit(s) (e.g., Trimble® Pathfinder Pro XRS or equivalent)
- PPE as required by the CSHASP (CDM 2006) and site-specific HASP (CDM 2008b)

4.2 Stationary Air Samples

This section describes the sampling rational, methods, and procedures that will be used to collect response action stationary air samples. Stationary air samples are air samples collected at a fixed location for a specified duration to meet project-specific goals. The three types of stationary samples collected in support of response actions are:

- Perimeter air samples
- Clearance air samples
- Equipment monitoring samples

Descriptions of these samples, and requirements for their collection, are provided in the following sections.

4.2.1 Perimeter Air Samples

For the purposes of this document, perimeter air samples are collected to determine the effectiveness of work practices and engineering controls at preventing off-site migration of airborne LA during exterior response actions. The site-specific removal work plan should be referenced to determine if an exterior response action is required.

4.2.1.1 Perimeter Air Sampling Rational

During the removal of LA asbestos-contaminated soils in exterior response actions, the downwind perimeter of the exclusion zone will be monitored for LA emissions by the collection of a stationary air sample at the exclusion zone boundary. The location of the perimeter air samples placed along the exclusion zone boundary will be determined by field sampling personnel after the exclusion zone fencing has been installed by the removal contractor and the dominate wind direction during the day of sampling. In general, one perimeter sample will be located downwind of the excavation, immediately outside of the exclusion zone fencing. Perimeter air samples will remain in the same location even if wind direction changes during sampling period; however, wind shift will be documented accordingly in the logbook. Perimeter air samples will be collected each day when exterior response actions require the removal of contaminated soils. Sample collection will cease once all contaminated soils have been removed from an exclusion zone. Data from these perimeter air samples will be compared against project-specific action levels stated in Table 3-2 to evaluate removal work practices and engineering controls.

4.2.1.2 Perimeter Air Sampling Methods

All perimeter air samples will be collected in accordance with the project-specific SOP CDM-LIBBY-14, Stationary Air Sample Collection (Appendix A). Each perimeter air sample will be collected at a rate of 1.0 to 10.0 liters per minute (L/min) and have a minimum volume of 1,200 liters. The flow rate will be set depending upon the type of sampling pump used (i.e., high versus low volume) and expected duration of the sampling period.

Perimeter air samples will be analyzed by TEM AHERA (EPA 1987), as discussed in Section 5.

4.2.1.3 Field QC Samples

The field QC samples associated with perimeter air samples are lot blanks and field blanks. These sample types are discussed in this section and summarized in Table 4-1.

Lot Blanks

Lot blanks are prepared by submitting unused cassettes for analyses prior to putting the group (lot) of cassettes into use. Lot blanks will be collected and analyzed at a frequency of 1 per 500 cassettes from the same lot. The lot blanks will be analyzed by PCM (NIOSH 1994a) and TEM AHERA (EPA 1987), with applicable project-specific laboratory modifications (CDM 2003). Lot blanks will be identified on the chain-of-custody (COC) form so that the analytical laboratory is aware of their use and can

immediately contact the A&E's laboratory coordinator if asbestos fibers are detected on the filters. If the lot is proved to be contaminated with 7 or more fibers per cubic centimeter (f/cc) by PCM or 1 or more LA structures per cubic centimeter (S/cc) by TEM AHERA, then the lot of cassettes will be discarded and a new lot of cassettes will be used.

Field Blanks

Each field team collecting stationary air samples will collect 1 field blank per day of air sampling. The field blank cassettes will come from the same lot as the cassettes used that day for air sample collection. One field blank per field team will be analyzed per week, at the discretion of the A&E's sample coordinator. The remainder of the field blanks collected by field teams, but not analyzed, will be submitted to the analytical laboratories marked for archive. The field blanks will be analyzed by TEM AHERA (EPA 1987), with applicable project-specific laboratory modifications (CDM 2003). The field blanks sample results will be reviewed by the A&E's sample coordinator in conjunction with the A&E's TL or FTL. If a field blank is contaminated with 1 or more LA S/cc by TEM AHERA, then the sample coordinator will contact appropriate personnel to determine whether the occurrence displays a trend in contamination or is isolated. The A&E laboratory coordinator will decide whether analysis of other archived field blanks is necessary. If it is determined that additional archived field blanks require analysis, they will be retrieved from archive at the analytical laboratory and analyzed. Field blank results will be evaluated to determine if field blank contamination is a sample collection procedure deficiency. If at any time field blank contamination appears to be a consistent deficiency in sample collection technique, the government or the A&E may immediately recommend additional formalized sample collection training and/or an increase in the frequency of field blanks submitted for analysis. If this is implemented, direction on required frequency, acceptance criteria, and corrective action will be provided in the form of an addendum memorandum or modification to this SAP.

4.2.2 Clearance Air Samples

If a property requires the removal of VCI, LA-contaminated interior dust, or LA-contaminated building materials, clearance air samples will be collected following removal activities. Clearance air samples are collected to determine if interior LA contamination levels have been reduced to project-specific action levels by interior response actions. The site-specific removal work plan should be referenced to determine if an interior response action is required.

4.2.2.1 Clearance Air Sampling Rational

Clearance air samples are collected from living spaces (e.g., living room, bedroom, hallway, garage, etc.) and attic spaces where LA-contaminated media (e.g., insulation, interior dust, building materials, etc.) are removed. After the removal contractor has removed the contaminated material, the A&E's removal oversight personnel will inspect the area to determine if clearance air sampling may commence. Clearance air samples will be collected to determine if interior response actions were successful at meeting the project-specific action levels. If sample results do not meet project-specific

action levels, additional cleaning will be performed and clearance samples re-collected. This iterative process will continue until project-specific action levels, as stated in Table 3-2, have been met. Once the action levels have been met, the area will be designated as adequately cleaned and restoration activities may begin.

4.2.2.2 Clearance Air Sampling Methods

Prior to collecting clearance air samples, an A&E health and safety team member will determine whether the area being sampled (cleared) is considered a living space or attic space, in order to compare the data collected to the project-specific action levels specified for these two different areas. The location of clearance air samples is dependent upon the size, type, and dimensions of each containment area requiring sampled. Five clearance samples will be collected in each containment area where a response action was performed. In cases where an attic shares air space with a living area and is included within the same NPE, the area must meet the project-specific action level for a living space as stated in section 4.3.1. The reader is referred to the RAWP (CDM 2008a) for more detail regarding preparing NPEs for clearance air sampling.

Each clearance air sample will be collected in accordance with TEM AHERA sampling guidance (EPA 1987) (Appendix A), with the following modifications:

Section II, B, 5 – 0.8 μm MCE cassettes will be used in place of MCE cassettes having a pore size less than or equal to 0.45 μm.

Section II, B, 17 – A total of seven air samples will be collected for each testing site (five field samples and two field blanks) rather than a minimum of 13 samples. No samples will be collected in ambient areas entering the abatement site (i.e., containment area). Both field blanks will be taken inside the abatement area (i.e., containment area) in place of one blank sample taken near entrance and one taken at the ambient site. No sealed blank will be carried with each sample set.

Section II, B, 24 – Field QC Samples and data quality objectives will be followed as discussed in this SAP.

All clearance air samples will be analyzed by TEM AHERA (EPA 1987), with applicable project-specific laboratory modifications (CDM 2003) as discussed in Section 5.

4.2.2.3 Field QC Samples

The Field QC samples associated with clearance air samples are lot blanks and field blanks. These sample types are discussed in this section and summarized in Table 4-1.

Lot Blanks

Lot blanks will be prepared and submitted as described in Section 4.2.1.3. Because the same type of sample cassette is used for the collection of perimeter, clearance, equipment monitoring, and personal air samples, lot blanks may be submitted collectively for these samples types. The analysis of and acceptance criteria for the lot

blanks for clearance samples will be the same as for perimeter air samples (Section 4.2.1.3).

Field Blanks

Each field team will collect two field blanks per containment area (i.e., NPE). The field blanks will come from the same lot as the cassettes used that day for air sample collection. Both of the field blanks will be collected in the removal area in close vicinity of a clearance air sample being collected. The field blanks will be analyzed by TEM AHERA (EPA 1987), with applicable project-specific laboratory modifications (CDM 2003). As with perimeter air field blanks, if a clearance field blank is contaminated with 1 or more LA S/cc, then the A&E's sample coordinator will contact appropriate personnel to determine whether the occurrence displays a trend in contamination or is isolated. The A&E's laboratory coordinator will decide whether analysis of other archived field blanks is necessary. If it is determined that additional archived field blanks require analysis, they will be retrieved from archive at the analytical laboratory and analyzed. Field blank results will be evaluated to determine if field blank contamination is a sample collection procedure deficiency. If at any time field blank contamination appears to be a consistent deficiency in sample collection technique, EPA or the A&E may immediately recommend additional formalized sample collection training and/or an increase in the frequency of field blanks submitted for analysis. If this is implemented, direction on required frequency, acceptance criteria, and corrective action will be provided in the form of an addendum memorandum or modification to this SAP.

4.3 Equipment Air Monitoring

Equipment air monitoring samples will be collected from various equipment used by the removal contractor during response action activities. Although there are no established frequencies for equipment air monitoring samples, the A&E's removal oversight staff will collect samples as deemed necessary by government representatives affiliated with the Libby project or the A&E's health and safety officer. Examples of equipment air monitoring samples include three-stage decontamination trailers, negative air machines, trailer-mounted or truck-mounted high-power vacuum units (e.g., Hurricane, etc.).

4.3.1 Equipment Air Monitoring Rationale

The purpose of the equipment air monitoring samples is to determine if the removal contractor is operating and maintaining removal equipment in accordance with manufacture specifications. Depending on equipment utilized by the removal contractor, equipment to be sampled will include:

- Decontamination trailers – clean room, once per week per site
- Negative-air machines – exhaust air, as necessary
- High-powered vacuum unites – exhaust air, as necessary

This list is not intended to be all inclusive. The A&E's removal oversight staff or A&E's health and safety officer may identify other equipment to monitor throughout the duration of removal activities. If additional equipment is identified as requiring sampling, it will first be discussed with the onsite government representative.

4.3.2 Equipment Air Monitoring Methods

All equipment air monitoring samples will be collected in accordance with CDM-LIBBY-14, Stationary Air Sample Collection (Appendix A). Each perimeter air sample will be collected at a rate of 1.0 to 10.0 L/min and have a minimum volume of 1,200 liters. Data from these equipment air monitoring samples will be compared against project-specific action levels stated in Table 3-2 to evaluate equipment maintenance.

All equipment air monitoring samples will be analyzed by TEM AHERA (EPA 1987) with applicable project-specific laboratory modifications (CDM 2003) as discussed in Section 5.

4.3.3 Field QC Samples

The field QC samples associated with equipment air monitoring sampling are lot blanks and field blanks. These Field QC Samples will be collected and analyzed in the same manner as perimeter air samples, which are discussed in Section 4.2.1.3 and summarized in Table 4-1.

4.4 Personal Air Sampling

Personal air samples are collected to determine if the respiratory protection used by personnel conducting response actions continues to be adequate to protect worker health. To determine if respiratory protection continues to be adequate, sample results should be compared to OSHA standard 29 CFR 1926.1101, which are provided in Table 3-2.

4.4.1 Personal Air Sampling Rationale

During response actions, personal air samples are collected to ensure worker health is protected. Sampling frequencies for personal air samples were established using task-based personal air sampling data collected during the 2002 and 2003 field seasons in Libby.

For interior response actions, personal air samples are collected on personnel performing the following activities: VCI removal, demolition, attic detailing, wet-wiping and/or HEPA vacuuming living spaces. For exterior response actions, personal air samples are collected on the following personnel: laborer, equipment operator, haul truck drivers, A&E's removal oversight staff. The number and frequency of sample collection is summarized in Appendix B of the RAWP (CDM 2008a).

4.4.2 Personal Air Sampling Methods

Personal air samples will be collected in accordance with OSHA Standard 29 CFR

1926.1101, Appendix B, *Sampling and Analysis* (provided in Appendix A) without modification. Personal air sampling will consist of collecting one time-weighted average (TWA) sample and one short-term exposure limit (STEL) (i.e., one 30-minute excursion) sample per task.

Samples will be collected on a 25-mm, 0.8 MCE filter. Air sampling pumps will be calibrated before and after each sampling event in accordance with CDM-LIBBY-14, by use of a primary standard calibration device (e.g. Dry-Cal) or a properly calibrated secondary standard calibration device (e.g. rotameter). Other pertinent personal air sample collection procedures such as labeling, documentation, and custody are described in Section 4.6.

All personal air samples will be analyzed by phase contrast microscopy (PCM) (NIOSH 1994a) with applicable project-specific laboratory modifications (CDM 2003). If PCM results are above the TWA and or STEL action levels defined in 29 CFR 1926.1101, the sample will be analyzed by TEM AHERA (EPA 1987), with applicable project-specific laboratory modifications (CDM 2003) to determine if the fibers detected are asbestos structures.

4.4.3 Field QC Samples

The field QC samples associated with personal air samples are lot blanks and field blanks. These sample types are discussed in this section and summarized in Table 4-1.

Lot Blanks

Lot blanks will be prepared and submitted as described in Section 4.2.1.3. Because the same type of sample cassette is used for the collection of perimeter, equipment monitoring, and personal air samples, lot blanks may be submitted collectively for these samples types. The analysis of the lot blanks for QC of personal samples and use of the results will be the same as for stationary air samples (Section 4.2.1.3).

Field Blanks

Each field team collecting stationary/personal air samples will collect one field blank per day of air sampling. The field blanks will come from the same lot as the cassettes used that day for air sample collection. The field blank will be collected in the vicinity of the location where the ambient air samples are collected. The field blanks will be analyzed using the same method as the personal air field samples submitted on the same COC - either PCM or TEM AHERA as applicable. If a field blank is contaminated with 1 or more LA S/cc, then the sample coordinator will contact appropriate personnel to determine whether the occurrence displays a trend in contamination or is isolated. The A&E laboratory coordinator will decide whether analysis of other archived field blanks is necessary. If it is determined that additional archived field blanks require analysis, they will be retrieved from archive at the analytical laboratory and analyzed. Field blank results will be evaluated to determine if field blank contamination is a sample collection procedure deficiency. If at any time field blank contamination appears to be a consistent deficiency in sample collection technique, EPA or its contractors may immediately recommend additional formalized

sample collection training and/or an increase in the frequency of field blanks submitted for analysis. If this is implemented, direction on required frequency, acceptance criteria, and corrective action will be provided in the form of an addendum memorandum or modification to this SAP.

4.5 Confirmation Soil Samples

If a property requires removal of vermiculite-containing or LA-contaminated soil, confirmation soil samples will be collected following removal activities. Confirmation soil samples are collected to determine if LA-contaminated soils have been removed to project-specific clearance criteria. The site-specific removal work plan should be referenced to determine if any areas require soil excavation.

4.5.1 Confirmation Soil Sampling Rationale

Following the excavation of the contaminated soils within the removal area to project-defined excavation depths, A&E's removal oversight staff will inspect the excavated sidewalls. If vermiculite is present in the sidewalls additional excavation may be deemed necessary, and the A&E's removal oversight staff will collect additional information (e.g., area, volume, obstacles, etc.) for a project-specific modification. All additional excavation will need prior approval by the onsite government representative.

The bottom of the excavation will also be inspected for visible vermiculite to determine if additional excavation is needed. With approval from the government representative, the A&E's removal oversight staff will delineate areas that will need further soil removal. The removal contractor will be directed to remove additional soil until, in the judgment of the A&E's removal oversight staff, the remaining soils are expected to meet soil clearance criteria or the excavation extends to the maximum excavation depth as described in the RAWP. When the soil remaining in the excavation area is expected to meet soil clearance criteria, a member of the A&E's removal oversight staff will collect confirmation soil samples. If the sample results indicate that the remaining soils are within the acceptable limits of the clearance criteria, the excavation will be considered complete. If the sample results indicate that clearance criteria have not been met within the excavation, the removal contractor will be directed to excavate the additional contaminated soils. Following the excavation of the additional contaminated soils, confirmation samples will be collected and the sample results evaluated to determine whether additional excavation is necessary. This iterative process will continue until the sample results indicate that no contaminated soils remain within the excavation or the excavation extends to the maximum excavation depth.

4.5.2 Confirmation Soil Sampling Methods

Each confirmation soil sample will be collected as a 30-point composite surface soil sample to characterize an area where contaminated soil has been removed. Each sample will be collected from 0 to 2 inches below the surface of the completed excavation and consist of nearly equal portions of soil from 30 randomly selected locations within the delineated sample area. Soils will be collected with a

decontaminated trowel and should fill at least half of a 1-gallon plastic zipper-top bag. Homogenization of the samples will occur by mixing the sample inside the zipper-top bag. Considering removal contractor work progress, property features, and laboratory turnaround time limitations, it will be the discretion of the A&E's removal oversight staff to decide the number of samples required to characterize the excavated area. However, to maintain sample collection consistency between the sampling team, at least one composite sample will be collected at a maximum of 2,500 square feet of excavation area.

4.5.2.1 Sampling During Excavation

Confirmation soil sampling may be performed simultaneously with the excavation of contaminated soils. That is, if the excavation is large enough, confirmation samples may be collected in areas of the excavating that are completed, while the removal contractor completes excavation in other areas. The A&E field team member will coordinate with the removal contractor prior to sampling to ensure future excavated work does not cross-contaminate sampled areas.

4.5.2.2 Sampling for Areas Not Excavated to Design Depth

Excavation along foundations, curbs and roads, sidewalks, and around trees present many challenges for the removal contractor. Excavation along/adjacent to these areas may cause additional hazards such as structure failure, slope failure, and falling trees. Therefore, excavation in these areas may not advance to the depth specified in the site-specific removal work plan (i.e., design depth). These areas, may be visually inspected only, or, may be sampled separately or in combination with other similar areas as necessary. Although no additional excavation may be feasible, these samples will be collected for documentation purposes.

Excavation around trees must be to a minimum depth of 4 inches below ground surface and as close to the site-specific removal work plan depth as possible without sacrificing the integrity of the root system. If sampling is not feasible due to root congestion, a visual inspection will be performed and quantities of vermiculite documented as low or intermediate. If high concentrations of vermiculite are present, A&E oversight will obtain approval from the government representative to allow excavation to continue.

4.5.2.3 Specific-Use Areas

Specific-use areas (SUAs) (e.g., flowerbeds, gardens, planters, etc.) may be sampled as one unit if the soil and any remaining vermiculite appear to be homogenous between the SUAs. No more than five SUAs may be sampled as one unit. In addition, the combined area of all SUAs sampled as one unit may be no larger than 1,000 square feet.

All confirmation soil samples will be collected in accordance with CDM-LIBBY-13. Other pertinent confirmation soil sample collection procedures such as labeling, documentation, and custody are described in Section 4.6.

All confirmation soil samples will be analyzed by polarized light microscopy (PLM) (NIOSH 1994b) as discussed in Section 5.

4.5.3 Field QC Samples

Two common field QC samples associated with soil sampling are equipment blanks and field duplicate samples. Equipment blanks are currently not required by EPA for soil sampling on the Libby Asbestos Project because: 1) detection levels for LA using current PLM analytical methods are not low enough to capture concentrations that would be expected in equipment blanks; and 2) the frequency of detection for LA in historically-collected project equipment blanks is extremely low.

Field duplicate samples are generally collected if information regarding the variability of co-located soil samples is required. As part of the CSS (CDM 2002), field duplicates were collected in order to understand the variability observed in field duplicate samples in Libby soil. For this reason, and due to the need for expedited soil sample results, field duplicates are not required for the response action program. Overall soil field duplicate sample collection frequency and data evaluation for the Libby Superfund Site is presented in the Draft Quality Assurance and Quality Control Summary Report for the Libby Asbestos Superfund Site (Syracuse Research Corporation [SRC] 2007).

4.6 General Processes

This section describes the general field processes that will be used to support the sampling described in this SAP and includes references to the CDM SOPs and project-specific procedures when applicable.

4.6.1 Equipment Decontamination

Equipment used to collect, handle, or measure soil and air samples will be decontaminated before removing the equipment from any exclusion zone. Decontamination will be conducted in accordance with CDM SOP 4-5, Field Equipment Decontamination at Non-radioactive Sites (Appendix A) with the following modifications:

Section 4.0, Required Equipment - Plastic sheeting will not be used during decontamination procedures. American Society for Testing and Materials Type II water will not be used. Rather, locally available de-ionized water will be used.

Section 5.0, Procedures - Decontamination water will not be captured and will be discharged to the ground at the worksite.

Section 5.6, Waste Disposal - Decontamination water will not be captured and will not be packaged, labeled, or stored as IDW. Decontamination water will be discharged to the ground at the worksite.

4.6.2 Investigation-Derived Waste

IDW at each property will consist of excess sample volume, spent decontamination supplies, and PPE. All IDW will be handled in accordance with CDM SOP 2-2, Guide to Handling IDW (Appendix A) with the following modifications:

Section 5.2, Offsite Disposal - All IDW (not including excess soil volume) will be collected in transparent garbage bags and marked "IDW" with an indelible ink marker. These bags will be deposited into the asbestos contaminated waste stream for disposal at the mine.

4.6.3 Field Sample Data Sheets

FSDSs will be completed for each sample in accordance with the current version of the CDM project-specific SOP, CDM-LIBBY-03. The FSDS is a record of specifics related to sample collection; the FSDS number (located in the upper right-hand corner) should be referenced in the field logbook. FSDSs are used to directly enter information into the project database and to connect sample analysis results to the sample collected. Example copies of FSDSs for all media to be sampled under this SAP are located in Appendix C.

4.6.4 Field Logbooks

Documentation of response action field activities conducted under this SAP will be recorded in field logbooks maintained specifically for this sampling program. Logbooks are maintained by the field administrative staff and are assigned unique identification numbers (i.e., controlled) for reference on FSDSs.

Detailed sampling notes will be recorded for each sample in accordance with CDM SOP 4-1, Field Logbook Content and Control. The field log is an accounting of activities at the site and will duly note problems or deviations from the governing plans and observations relating to the sampling and analysis program. A new logbook page will be completed for each property visited. The header information should include the address, and the property owner's name. When closing out a logbook page with lineout and signature, the author will also print his/her name underneath the signature. The sample coordinator will manage the logbooks and will email scanned copies of field logbooks, as they are completed, to the Volpe Center and the A&E's project file coordinator in Denver. Original logbooks will be maintained in the A&E's office in Libby, Montana.

4.6.5 Sample Labeling and Identification

A unique alphanumeric code, or Index Identification (ID), will identify each sample collected during response action sampling events. The coding system will provide a tracking record to allow retrieval of information about a particular sample and to ensure that each sample is uniquely identified. Index IDs will be sequential and not be representative of any particular building or equipment. Index IDs will correlate with sample location IDs, which will be identified on FSDSs and in the field logbooks.

The sample labeling scheme is as follows:

2R-XXXXX

Where:

2R identifies that a sample is collected in accordance with this SAP
XXXXX represents a 5-digit numeric code

Preprinted adhesive Index ID labels will be signed out to sampling personnel by a member of the administration team using an Index ID logbook. The labels are controlled to prevent duplication in assigning sample IDs. The labels will be affixed to both the sample cassette and sample bag for air samples, and both the inner and outer sample bags for soil samples. Index ID labels will be used in accordance with CDM SOP 1-2, Sample Custody.

4.6.6 Photographic Documentation

Photographs will be taken with a digital camera at any place that field sampling personnel determine necessary. Electronic photograph files will be saved each day to a project-designated computer housed at the A&E's Libby office and named so that photographs for a particular property or activity (e.g., bulk insulation removal, interior dust removal, etc.) can easily be retrieved. The photograph file naming convention is as follows:

John Doe 45 Montana Ave Attic-Removal 09-21-07 (01)

Where:

John Doe = property owner's name
45 Montana Ave = address where removal activities occurred
Attic Removal = the activity being documented
09-21-07 = the date the photo was taken
(01) = the number of the photo taken at that property that day

Following completion of removal activities, all photo files pertaining to a property will be copied onto a compact disc and filed in Libby along with other property-specific documentation.

4.6.7 Corrections to and Deviations from Governing Documents

Logbook requirements are described in CDM SOP 4-1, Field Logbook Content and Control, with modification. For the logbooks, a single strikeout initial and date is required for documentation changes. The correct information should be entered in close proximity to the erroneous entry. These procedures will also be followed for the correction of any field form (Appendix E). All deviations from the guiding documents will be recorded in the logbooks and the Libby Asbestos Project Record of Deviation/Request for Modification Form. Any major deviations will be documented according to the QA Manual (CDM 2007b).

4.6.8 GPS Point Collection

GPS location coordinates will be collected in accordance with CDM-LIBBY-09. Coordinates for buildings will be collected only if the building does not already have an assigned GPS location.

4.6.9 Field Sample Custody

Sample custody and documentation will follow the requirements specified in CDM SOP 1-2, Sample Custody, and project-specific guidance for the completion of FSDSs (CDM-LIBBY-03) and production of COC forms (CDM-LIBBY-11) using eLASTIC. All samples and sampling paperwork will be relinquished by A&E sampling personnel to the A&E's sample coordinator at the end of each day. The sample coordinator will be responsible for managing all field forms. Upon completion of the FSDS by the sampler and a subsequent QC check by an independent field team member, the sample coordinator will use the FSDS to generate a COC, following the procedures listed in CDM-LIBBY-11. Three copies of the COC will then be printed using three-part carbonless paper. One copy will be filed in the Libby A&E office and the other two will accompany sample shipments. The sample coordinator will check the COC against the samples in the shipping container to ensure consistency and accuracy and will hand-deliver or ship samples as appropriate. If any errors are found on the COC after delivery/shipment, the paper copy of the COC maintained by the A&E in Libby will be corrected by the sample coordinator with a single strikeout, initial, and date. The corrected copy will then be faxed to the analytical laboratory and the information updated in eLASTIC. A revised sample data file will then be transmitted (emailed) to Volpe by the A&E's sample coordinator.

4.6.10 Chain-of-Custody Requirements

The COC is employed as physical evidence of sample custody and control. This record system provides the means to identify, track, and monitor each individual sample from the point of collection through final data reporting. A completed COC record is required to accompany each shipment of samples.

Chain-of-custody procedures and sample shipment for all samples collected in accordance with this SAP will follow the requirements stated in the project-specific guidance for electronic COC (CDM-LIBBY-11) and CDM SOP 1-2, Sample Custody (Appendix A) with the following modification:

5.1 Transfer of Custody and Shipment – A COC will not be completed in the field. A sample-specific FSDS will be used as custody record and samples will be relinquished to the A&E's sample coordinator for COC production as described in section 4.6.10.

All samples will be relinquished to the A&E's sample coordinator by the sampler under strict custody. The A&E's sample coordinator will follow custody procedures to ensure proper sample custody between acceptance of samples from the samplers and shipment to the laboratory or A&E's Close Support Facility.

4.6.11 Sample Packaging and Shipping

Samples will be packaged and shipped in accordance with CDM SOP 2-1, Packaging and Shipping of Environmental Samples (Appendix A) with the following modifications:

1.4 Required Equipment – Vermiculite (or other absorbent material) or ice will not be used for packaging or shipping samples.

1.5 Procedures – No vermiculite or other absorbent material will be used to pack the samples. No ice will be used.

Custody seals will be placed on each sample and on at least two sides of the shipping container, if applicable. All samples will be hand-delivered to the laboratory, picked up by a delivery service courier, or shipped by a delivery service to the designated laboratories, as necessary.

4.6.12 Field Equipment Maintenance

Air sampling pump calibrations will be conducted and documented in accordance with CDM-LIBBY-14, Stationary Air Sample Collection (Appendix A). Field equipment maintenance will be conducted and documented in accordance with CDM SOP 5-1, Control of Measurement and Test Equipment (Appendix A).

Table 4-1 Summary of Field QC Samples

Sample Type	Associated QC Sample	Collection Frequency	Analysis Frequency	Analysis Request	Acceptance Criteria
Perimeter Stationary Air	lot blank	1 lot blank per 500 unused sample cassettes[1]	same as collection frequency	PCM and TEM AHERA	7 or more f/cc by PCM or 1 or more LA S/cc by TEM AHERA
Perimeter Stationary Air	field blank	1 per team per day	1 per team per week	TEM AHERA	1 or more LA S/cc by TEM AHERA
Clearance Stationary Air	lot blank	1 lot blank per 500 unused sample cassettes[1]	same as collection frequency	PCM and TEM AHERA	7 or more f/cc by PCM or 1 or more LA S/cc by TEM AHERA
Clearance Stationary Air	field blank	2 per set of 5 clearance field samples	same as collection frequency	TEM AHERA	1 or more LA S/cc by TEM AHERA
Equipment Monitoring Stationary Air	lot blank	1 lot blank per 500 unused sample cassettes[1]	same as collection frequency	PCM and TEM AHERA	7 or more f/cc by PCM or 1 or more LA S/cc by TEM AHERA
Equipment Monitoring Stationary Air	field blank	1 per team per day	1 per team per week	TEM AHERA	1 or more LA S/cc by TEM AHERA
Personal Air	lot blank	1 lot blank per 500 unused sample cassettes[1]	same as collection frequency	PCM and TEM AHERA	7 or more f/cc by PCM or 1 or more LA S/cc by TEM AHERA
Personal Air	field blank	1 per team per day	1 per team per week	PCM or TEM AHERA[2]	1 or more LA S/cc by TEM AHERA
Confirmation Soil	none	not applicable	not applicable	not applicable	not applicable

PCM – phase contrast microscopy
TEM – transmission electron microscopy
AHERA – Asbestos Hazard Emergency Response Act
f/cc – fibers per cubic centimeter
S/cc – structures per cubic centimeter

[1]Since the same type of cassette is used for all air samples, lot blanks may be submitted collectively for these sample types

[2]Personal air sample field blanks will be analyzed using the same method as the field samples submitted on the same chain-of-custody form

Section 5
Laboratory Operations

A team of laboratories have been contracted to analyze samples associated with the Libby response action program, including an onsite laboratory that can meet expedited (e.g., 2-hour, 6-hour, 24-hour) turnaround times necessary to maintain the removal schedule. Each laboratory used for sample analysis has participated in, and acceptably analyzed, the required parameters in the last two proficiency examinations from the National Institute of Standards and Technology/National Voluntary Laboratory Accreditation Program. Each laboratory is also required to analyze project-specific performance evaluation samples or other test reference materials when requested. These analyses must be performed before any field samples are submitted to the laboratory and are used to confirm the laboratory's capabilities. These test samples may be subsequently submitted to the laboratory at regular intervals as part of a field sample set for QC purposes. In addition, the laboratory must have participated in the laboratory training program developed by the Libby laboratory team.

This section discusses the analytical methods, custody and documentation procedures, quality assurance/quality control (QA/QC) requirements, and data management requirements to be employed or met by project laboratories in support of the Libby response action program.

5.1 Analytical Methods and Turnaround Times

This section describes the analytical methods used for response action samples.

5.1.1 TEM AHERA - Perimeter and Equipment Monitoring Air Samples

Perimeter and equipment monitoring air samples will be analyzed by TEM AHERA in accordance with 40 CFR Chapter 1, Part 763, Subpart E, Appendix A, *Interim Transmission Electron Microscopy Analytical Methods - Mandatory and Non-mandatory - and Mandatory Section to Determine Completion of Response Actions.* All project-specific laboratory modifications to the TEM AHERA method, as documented in *Modification to Laboratory Activities* (CDM 2003), will be applied. The standard turnaround time for perimeter air sample results is 24 hours unless the COC accompanying the samples sent to the laboratory indicates otherwise.

The laboratory will attempt to achieve the method analytical sensitivity of 0.005 S/cc using direct sample preparation techniques and will employ project-specific stopping rules as documented in Laboratory Modification #LB-000017 (CDM 2003) unless other direction is provided. Users of the response action data should be aware that because of the project-specific stopping rule, reported sensitivities may be higher than the method analytical sensitivity. In the event that a perimeter air sample is determined to be overloaded by the analyst, the laboratory will contact either the A&E's sample coordinator or the project health and safety officer to report the issue. When

necessary, the analyst will proceed with analysis using the indirect sample preparation method, EPA-LIBBY-08 (EPA 2007).

5.1.2 TEM AHERA - Clearance Air Samples

As specified on the COC, clearance air samples will be analyzed by TEM AHERA in accordance with 40 CFR Chapter 1, Part 763, Subpart E, Appendix A, *Interim Transmission Electron Microscopy Analytical Methods - Mandatory and Non-mandatory - and Mandatory Section to Determine Completion of Response Actions*. All project-specific laboratory modifications to the TEM AHERA method, as documented in *Modification to Laboratory Activities* (CDM 2003), will be applied. The standard turnaround time for clearance air sample results is 24 hours unless the COC accompanying the samples sent to the laboratory indicates otherwise.

The laboratory will achieve the method analytical sensitivity of 0.005 S/cc using direct sample preparation techniques. If the analytical sensitivity cannot be achieved, or any clearance air sample is deemed to be overloaded, the laboratory will contact the A&E's sample coordinator or health and safety officer for further direction on how to proceed (e.g., to either continue or cancel the analysis of the clearance sample set).

5.1.3 PCM - Personal Air Samples

Personal air samples will be analyzed by NIOSH 7400, Issue 2, *Asbestos and Other Fibers by PCM* (NIOSH 1994a), as specified on the COC. All project-specific laboratory modifications to the PCM method, as documented in *Modification to Laboratory Activities* (CDM 2003), will be applied. The standard turnaround time for personal air sample results is 24 hours unless the COC accompanying the samples sent to the laboratory indicates otherwise.

The laboratory will attempt to achieve the level of detection specified by the analytical method (<0.01 f/cc) using direct sample preparation techniques but may employ project stopping rules as documented in Laboratory Modification LB-000015. Users of this response action data should be aware that because of the project-specific stopping rule, reported detection levels may be higher than the method detection level. In the event that a personal air sample is determined to be overloaded by the analyst according to the criteria described in Laboratory Modification LB-000015 (CDM 2003), the laboratory analyst will proceed with analysis using a standard PCM indirect sample preparation method.

5.1.4 TEM AHERA - Personal Air Samples

As previously discussed in Section 3, personal air PCM sample results that exceed the TWA and/or STEL action levels defined in 29 CFR 1926.1101 will be analyzed by the TEM AHERA method in accordance with 40 CFR Chapter 1, Part 763, Subpart E, Appendix A, *Interim Transmission Electron Microscopy Analytical Methods - Mandatory and Non-mandatory - and Mandatory Section to Determine Completion of Response Actions*, with project-specific modifications. This secondary analysis will identify if the fibers detected by PCM are asbestos structures. When TEM AHERA analyses are requested by the A&E's health and safety officer, the original COC requesting PCM analysis will

be revised by the A&E's sample coordinator to include TEM AHERA analysis. The original COC with markups and a revised electronic COC printout will be faxed to the laboratory for their records. The standard turnaround time for these personal air sample results is 72 hours unless the COC accompanying the samples sent to the laboratory indicates otherwise.

For personal air samples analyzed by TEM AHERA, the laboratory will attempt to achieve the method analytical sensitivity of 0.005 S/cc using direct sample preparation techniques and may employ project-specific stopping rules. Users of this response action data should be aware that because of the project-specific stopping rule, reported sensitivities may be higher than the method analytical sensitivity. In the event that a personal air sample is determined to be overloaded by the analyst, the laboratory will contact either the A&E's sample coordinator or health and safety officer to report the issue. When requested, the analyst will proceed with analysis using the indirect sample preparation method (EPA-LIBBY-08) (EPA 2007).

5.1.5 PLM - Confirmation Soil Samples

Confirmation soil samples will be analyzed by NIOSH 9002, Issue 2, *Asbestos (bulk) by PLM* (NIOSH 1994b), as specified on the COC. All project-specific laboratory modifications to the NIOSH 9002 method, as documented in *Modification to Laboratory Activities* (CDM 2003), will be applied. The standard turnaround time for confirmation soil sample results is 24 hours unless the COC accompanying the samples sent to the laboratory indicates otherwise.

Because the method level of detection is estimated (at less than 1 percent asbestos), no specific level of detection has been established for project samples analyzed using NIOSH 9002.

Following receipt at the onsite analytical laboratory, confirmation soil samples will be thoroughly homogenized in accordance with project requirements then split. One sample split will be analyzed by the onsite laboratory and the other returned under strict custody to the A&E's sample coordinator for archival at the A&E's Close Support Facility in Denver.

5.1.6 Field QC Samples

Air cassette lot blanks will be analyzed by both PCM and TEM AHERA (with applicable project-specific laboratory modifications) to the respective method analytical sensitivities. Lot blanks will be identified on the COC so that the analytical laboratory is aware of their use and can contact the A&E's sample coordinator immediately if asbestos fibers are detected on the filters.

Air field blanks will be analyzed by either PCM or TEM AHERA as specified on the COC. Respective method analytical sensitivities will be achieved.

5.2 Holding Times

No preservation requirements or holding times are established for soil or air samples

collected for asbestos analysis in accordance with this SAP. Soils, however, shall be oven-dried prior to long-term storage to mitigate the potential for mold growth.

5.3 Laboratory Custody Procedures

Laboratory custody procedures are provided in the QA management plans for each project laboratory. These plans were reviewed by the A&E as part of the laboratory procurement process and were independently audited and found to be satisfactory by EPA's laboratory audit team.

The basic laboratory sample custody process is as described herein. Upon receipt at the laboratory, each sample shipment will be inspected to assess the condition of the shipping and the individual samples. This inspection will include verifying sample integrity. The accompanying COC records will be cross-referenced with all of the samples in the shipment. The laboratory sample custodian will sign the COC records and maintain a copy for their project files; the original COC will be appended to the hard copy data report that is returned to the A&E's laboratory coordinator within the laboratory report. Next, the sample custodian may continue the COC record process by assigning a unique laboratory number to each sample on receipt. This number will identify the sample through all further handling at the laboratory. It is the laboratory's responsibility to maintain internal logbooks and records throughout sample preparation, analysis, data reporting, and sample archiving.

5.4 Laboratory QA/QC

The Libby Asbestos Project laboratory QA program consists of laboratory certifications, team training and mentoring, analyst training, and laboratory audits. Key components of the laboratory QA program are discussed below, while detailed QA/QC procedures and requirements are discussed in the Draft Site-wide Quality Assurance Project Plan (SWQAPP) (CDM 2007a).

Laboratories that analyze field samples on the Libby project must maintain particular certifications and must satisfactorily complete project-specific training requirements to ensure that proper QA/QC practices are conducted during sample analysis.

Each laboratory is required to participate in an onsite laboratory audit carried out by the EPA Superfund Analytical Services Branch, who is independent of the Libby team members. Laboratories may also be assessed by the EPA laboratory contractor (i.e., the A&E) as necessary to determine the ability of each laboratory to perform the work.

Lastly, analytical laboratories will be provided a copy of and will adhere to the requirements of this SAP. Samples collected under this SAP will be analyzed in accordance with standard EPA and/or nationally-recognized analytical procedures (i.e., Good Laboratory Practices) in order to provide analytical data of known quality and consistency.

5.5 Laboratory Documentation and Reporting

All deviations from project-specific and method guidance documents will be recorded on the Libby Asbestos Project Laboratory Record of Modification Form (Appendix E). The Record of Modification Form will be used to document all permanent and temporary changes to analytical procedures. In addition, the Record of Modification Form will be used to document any information of interest as requested by EPA project management. As modifications are implemented, the A&E's laboratory coordinator will communicate the changes to the project laboratories and copies of signed and unsigned laboratory modifications will be tracked and posted in the LibbyLaboratory e-room. Additional details regarding the completion and approval process for modification forms are provided in the Draft SWQAPP (CDM 2007a).

Sample results data will be delivered to the Volpe Center and the A&E's laboratory coordinator both in hard copy and as an electronic data deliverable (EDD) in the most recent project-specific format. Electronic copies of all project deliverables, including graphics, will be filed by project number. Electronic files will be routinely backed up and archived according to individual laboratory processes.

5.6 Laboratory Nonconformance

Laboratories will immediately notify the A&E's site manager or sample coordinator if major problems occur (e.g., catastrophic equipment failure). Other nonconformance issues, such as those found during performance evaluations or audits, will be addressed on a case-by-case basis by the EPA's laboratory audit team.

Section 6
Assessments and Oversight

Assessments and oversight reports to management are necessary to ensure that procedures are followed as required and that deviations from procedures are documented. These reports also serve to keep management current on field activities. Assessment, oversight reports, and response actions are discussed below.

6.1 Assessments

Performance assessments are quantitative checks on the quality of a measurement system and are appropriate to analytical work. Performance assessments for the laboratories may be accomplished by submitting blind reference material (i.e., performance evaluation samples). These assessment samples are samples with known concentrations that are submitted to the laboratories without identifying them as such to the laboratories. Laboratory audits may be conducted upon request from the EPA remedial project manager or Volpe Center project manager.

System assessments are qualitative reviews of different aspects of project work to check use of appropriate QC measures and the general function of the QA system. Project assessments will be performed under the direction of the A&E's QA director, with support from the A&E's project QA coordinator. Quality Procedure 6.2, as defined in the A&E's QA Manual (CDM 2007b), defines requirements for conducting system assessments. Due to the amount of sampling and the duration of the Libby project, both a field audit and an office audit are scheduled for response action work annually.

6.2 Corrective Actions

Corrective actions will be implemented on a case-by-case basis to address quality problems. Minor actions taken in the field to immediately correct a quality problem will be documented in the applicable field logbook and a verbal report will be provided to the A&E's project manager and/or site manager. Major corrective actions taken in the field will be approved by the EPA remedial project manager, Volpe Center project manager, and A&E's project manager prior to implementation of the change. Major response actions are those that may affect the quality or objective of the investigation. Quality problems that cannot be corrected quickly through routine procedures may require implementation of a corrective action request (CAR) form, as provided in the A&E's QA Manual (CDM 2007b).

All formal response actions will be submitted to either the A&E's QA Director or project QA coordinator for review and issuance. The A&E's project manager or project QA coordinator will notify their QA director when quality problems arise that may require a formal response action. CAR forms will be completed according to Quality Procedure 8.1 of the A&E's QA Manual (CDM 2007b).

In addition, when modifications to this SAP are required, either for field or laboratory activities, a Libby Asbestos Project Record of Modification Form (Appendix E) must be completed. Additional details regarding the completion and approval process for Record of Modification Forms are provided in the Draft SWQAPP (CDM 2007a).

6.3 Reports to Management

QA reports will be provided to management for routine audits and whenever quality problems are encountered. Field staff will note any quality problems on FSDSs or in field log notes. Further, the A&E's project manager will inform the project QA coordinator upon encountering quality issues that cannot be immediately corrected. Weekly reports and change request forms are not required for work performed under this SAP.

Section 7
Data Review and Verification

Laboratory results will be reviewed and verified for compliance with project reporting requirements. Data review and verification, and DQO reconciliation are discussed in Sections 7.1 and 7.2, respectively.

7.1 Data Review and Verification Requirements

Data review (i.e., QC review) includes cross-checking that sample IDs and sample dates have been reported correctly on the preliminary laboratory report, and that calculated analytical sensitivities or detection levels are as expected. Once the preliminary results are received from the laboratory (typically via facsimile), the A&E's sample coordinator performs the data review and reports any discrepancies to the laboratory in a timely manner. The laboratory will then correct and reissue the results report.

Data verification includes checking that results have been transferred correctly from laboratory data printouts to the finalized laboratory report and to the EDD, and that both the laboratory report and EDD are complete before they are submitted to the Volpe Center data manager. This function is served, to a limited extent, by the A&E's laboratory coordinator; however, data verification for this project is primarily performed as a function of built-in QC checks in the project database when data is uploaded. As a result, data users may be the first personnel to encounter discrepancies. If discrepancies are found, the data user will contact the A&E's sample coordinator, who will then notify the appropriate laboratory and/or the Volpe Center data manager in order to correct the issue.

7.2 DQO Reconciliation

The DQOs presented in Section 3 will be reconciled during the data review process. During this process, the A&E's sample coordinator provides sample results to members of the A&E's health and safety and removal oversight teams, whereby these team members will compare the results against the project-specific action levels discussed in the DQOs. Attainment of project DQOs results in removal work progressing at specific residential and commercial properties, as discussed in the RAWP (CDM 2008a). Non-attainment of project DQOs will be immediately discussed with the onsite Volpe Center representative, as rework (e.g., additional interior wet-wiping followed by additional sampling) may be necessary in order to achieve DQOs.

Section 8
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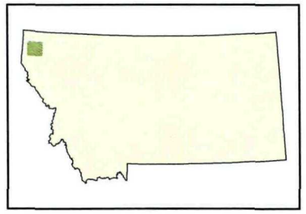
Figure 2-1
Site Location Map
Libby Asbestos Site
Lincoln County, Montana

Legend

- Highway
- County Boundary
- Roads
- Railroad
- Approximate Site Boundary
- Water
- City



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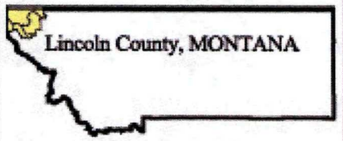
Locus Map



Rainy Creek Road

Mine Site

Lincoln County Landfill

Libby Dam

Former Export Plant

Former Screening Plant

Plummer Elementary School

KDC Bluff Property

KDC Flyway

Libby High School

Libby Middle School

Kootenai River

McGrade Elementary School

Area of Response Action

Libby, Montana

Figure 2-2

1 0 1 Miles

N

CDM

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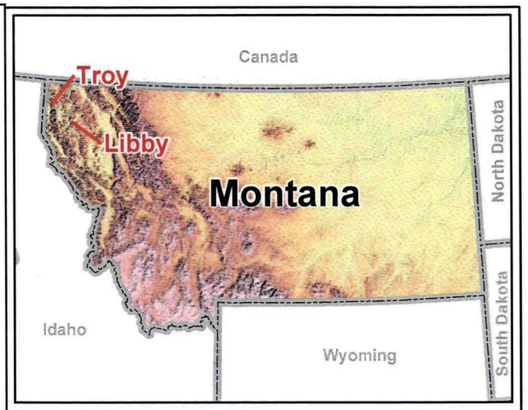

Legend

- OU1 - Former Export Plant
- OU2 - Former Screening Plant, Flyway Property, Highway 37 right-of-way adjacent to the Screeing Plant, and the KDC Bluffs
- OU3 - Mine site area, Kootenai River, Rainy Creek and Rainy Creek Road
- OU4 - Residential, Commercial, Industrial Properties including Schools and Parks
- OU5 - Former Stimson Lumber Mill
- OU6 - BNSF Railyard, Tracks, and Right -of-way
- OU7 - Troy

N
W E
S

Miles

0 1 2 4

1 inch equals 1.5 miles

Aerial Phota Data Sources

Libby Color Image Source:
CDM 2002
Flight Dates: 10/14/02 to 10/18/02
Aerials flown by Visual Intelligence Systems, Inc.
1505 Highway 6 South
Houston, TX 77077

Gray Scale DOQ Source:
U.S. Geological Survey Digital Orthophoto Quarter-Quadrangles (DOQQ) 28-Jul-95
Seamless Download (http://seamless.usgs.gov/website/seamless/)
EROS Data Center
USGS EROS Data Center
47914 252nd Street
Sioux Falls
South Dakota
57198-0001

Troy Color Image Source:
National Agriculture Imagery Program (NAIP) 2005
Sales Section
USDA Farm Service Agency
Aerial Photography Field Office
2222 West 2300 South
Salt Lake City UT 84119-2020
Tel: 801-975-3503
Fax: 801-975-3532
Email: apfo.sales@slc.usda.gov
Website: http://www.apfo.usda.gov

Note:
The OU boundaries depicted are based on the definitions found in the Libby Asbestos Conceptual Site Model. Because investigation of the nature and extent of contamination continues, the OU boundaries are subject to change. These OU boundaries are current as of June 4, 2007.

Map Date: 6/4/2007

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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Figure 2-3

Operable Unit (OU) Boundaries
Libby Asbestos Site
Libby, Montana

CDM

Document: R:\Libby_CSS\Figure1-3_CSS_OUMap_11x17size_OU_v2.mxd

APPENDIX A
Standard Operating Procedures

National Guidelines

Appendix A to Subpart E of Part 763 – Interim Transmission Electron Microscopy Analytical Methods – Mandatory and Nonmandatory – and Mandatory Section to Determine Completion of Response Actions

Sampling and Analysis – Non-mandatory, Title 29 Code of Federal Regulations, Part 1926.1101, Appendix B

CDM Standard Operating Procedures

Sample Custody (CDM SOP 1-2)

Packaging and Shipping of Environmental Samples (CDM SOP 2-1)

Guide to Handling of Investigation-Derived Waste (CDM SOP 2-2)

Field Logbook Content and Control (CDM SOP 4-1)

Field Equipment Decontamination at Non-radioactive Sites (CDM SOP 4-5)

Control of Measurement and Test Equipment (CDM SOP 5-1)

Project-specific Standard Operating Procedures

Project-specific Standard Operating Procedure for Completion of Field Sample Data Sheets (CDM-LIBBY-03)

Project-specific Standard Operating Procedure for Global Positioning System Coordinate Collection and Handling (CDM-LIBBY-09)

Project-specific Standard Operating Procedure for eLASTIC (CDM-LIBBY-11)

Project-specific Standard Operating Procedure for Confirmation Soil Sample Collection (CDM-LIBBY-13)

Project-specific Standard Operating Procedure for Stationary Air Sample Collection (CDM-LIBBY-14)

Appendix A to Subpart E of Part 763 -- Interim Transmission Electron Microscopy Analytical Methods -- Mandatory and Nonmandatory -- and Mandatory Section to Determine Completion of Response Actions

I. Introduction

The following appendix contains three units. The first unit is the mandatory transmission electron microscopy (TEM) method which all laboratories must follow; it is the minimum requirement for analysis of air samples for asbestos by TEM. The mandatory method contains the essential elements of the TEM method. The second unit contains the complete non-mandatory method. The non-mandatory method supplements the mandatory method by including additional steps to improve the analysis. EPA recommends that the non-mandatory method be employed for analyzing air filters; however, the laboratory may choose to employ the mandatory method. The non-mandatory method contains the same minimum requirements as are outlined in the mandatory method. Hence, laboratories may choose either of the two methods for analyzing air samples by TEM.

The final unit of this Appendix A to subpart E defines the steps which must be taken to determine completion of response actions. This unit is mandatory.

II. Mandatory Transmission Electron Microscopy Method

A. Definitions of Terms

1. *Analytical sensitivity* -- Airborne asbestos concentration represented by each fiber counted under the electron microscope. It is determined by the air volume collected and the proportion of the filter examined. This method requires that the analytical sensitivity be no greater than 0.005 structures/cm ^{3}.

2. *Asbestiform* -- A specific type of mineral fibrosity in which the fibers and fibrils possess high tensile strength and flexibility.

3. *Aspect ratio* -- A ratio of the length to the width of a particle. Minimum aspect ratio as defined by this method is equal to or greater than 5:1.

4. *Bundle* -- A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

5. *Clean area* -- A controlled environment which is maintained and monitored to assure a low probability of asbestos contamination to materials in that space. Clean areas used in this method have HEPA filtered air under positive pressure and are capable of sustained operation with an open laboratory blank which on subsequent analysis has an average of less than 18 structures/mm ^{2} in an area of 0.057 mm ^{2} (nominally 10 200-mesh grid openings) and a maximum of 53 structures/mm ^{2} for any single preparation for that same area.

6. *Cluster* -- A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two

intersections.

7. *ED* -- Electron diffraction.

8. *EDXA* -- Energy dispersive X-ray analysis.

9. *Fiber* -- A structure greater than or equal to 0.5 µm in length with an aspect ratio (length to width) of 5:1 or greater and having substantially parallel sides.

10. *Grid* -- An open structure for mounting on the sample to aid in its examination in the TEM. The term is used here to denote a 200-mesh copper lattice approximately 3 mm in diameter.

11. *Intersection* -- Nonparallel touching or crossing of fibers, with the projection having an aspect ratio of 5:1 or greater.

12. *Laboratory sample coordinator* -- That person responsible for the conduct of sample handling and the certification of the testing procedures.

13. *Filter background level* -- The concentration of structures per square millimeter of filter that is considered indistinguishable from the concentration measured on a blank (filters through which no air has been drawn). For this method the filter background level is defined as 70 structures/mm ^{2}.

14. *Matrix* -- Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

15. *NSD* -- No structure detected.

16. *Operator* -- A person responsible for the TEM instrumental analysis of the sample.

17. *PCM* -- Phase contrast microscopy.

18. *SAED* -- Selected area electron diffraction.

19. *SEM* -- Scanning electron microscope.

20. *STEM* -- Scanning transmission electron microscope.

21. *Structure* -- a microscopic bundle, cluster, fiber, or matrix which may contain asbestos.

22. *S/cm 3* -- Structures per cubic centimeter.

23. *S/mm 2* -- Structures per square millimeter.

24. *TEM* -- Transmission electron microscope.

B. Sampling

1. The sampling agency must have written quality control procedures and documents which verify compliance.

2. Sampling operations must be performed by qualified individuals completely independent of the abatement contractor to avoid possible conflict of interest (References 1, 2, 3, and 5 of Unit II.J.).

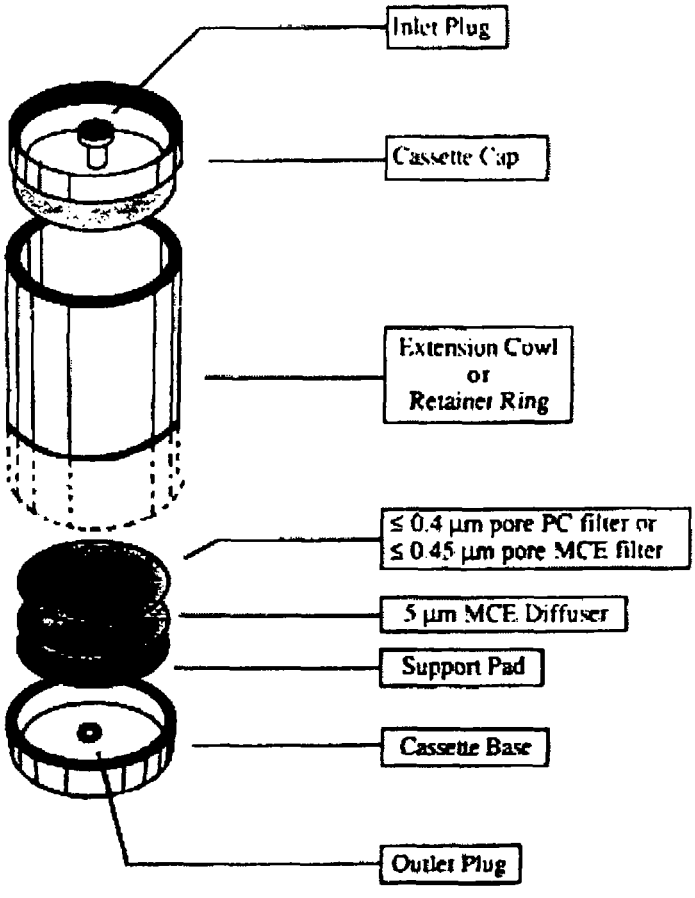
3. Sampling for airborne asbestos following an abatement action must use commercially available cassettes.

4. Prescreen the loaded cassette collection filters to assure that they do not contain concentrations of asbestos which may interfere with the analysis of the sample. A filter blank average of less than 18 s/mm ^{2} in an area of 0.057 mm ^{2} (nominally 10 200-mesh grid openings) and a single preparation with a maximum of 53 s/mm ^{2} for that same area is acceptable for this method.

5. Use sample collection filters which are either polycarbonate having a pore size less than or equal to 0.4 µm or mixed cellulose ester having a pore size less than or equal to 0.45 µm.

6. Place these filters in series with a 5.0 µm backup filter (to serve as a diffuser) and a support pad. See the following Figure 1:

FIGURE 1--SAMPLING CASSETTE CONFIGURATION



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7. Reloading of used cassettes is not permitted.

8. Orient the cassette downward at approximately 45 degrees from the horizontal.

9. Maintain a log of all pertinent sampling information.

10. Calibrate sampling pumps and their flow indicators over the range of their intended use with a recognized standard. Assemble the sampling system with a representative filter (not the filter which will be used in sampling) before and after the sampling operation.

11. Record all calibration information.

12. Ensure that the mechanical vibrations from the pump will be minimized to prevent transferral of vibration to the cassette.

13. Ensure that a continuous smooth flow of negative pressure is delivered by the pump by damping out any pump action fluctuations if necessary.

14. The final plastic barrier around the abatement area remains in place for the sampling period.

15. After the area has passed a thorough visual inspection, use aggressive sampling conditions to dislodge any remaining dust. (See suggested protocol in Unit III.B.7.d.)

16. Select an appropriate flow rate equal to or greater than 1 liter per minute (L/min) or less than 10 L/min for 25 mm cassettes. Larger filters may be operated at proportionally higher flow rates.

17. A minimum of 13 samples are to be collected for each testing site consisting of the following:

a. A minimum of five samples per abatement area.

b. A minimum of five samples per ambient area positioned at locations representative of the air entering the abatement site.

c. Two field blanks are to be taken by removing the cap for not more than 30 seconds and replacing it at the time of sampling before sampling is initiated at the following places:

i. Near the entrance to each abatement area.

ii. At one of the ambient sites. (DO NOT leave the field blanks open during the sampling period.)

d. A sealed blank is to be carried with each sample set. This representative cassette is not to be opened in the field.

18. Perform a leak check of the sampling system at each indoor and outdoor sampling site by activating the pump with the closed sampling cassette in line. Any flow indicates a leak which must be eliminated before initiating the sampling operation.

19. The following Table I specifies volume ranges to be used:

TABLE 1--NUMBER OF 200 MESH EM GRID OPENINGS (0.0057 MM^2) THAT NEED TO BE ANALYZED TO MAINTAIN SENSITIVITY OF 0.005 STRUCTURES/CC BASED ON VOLUME AND EFFECTIVE FILTER AREA

Effective Filter Area 385 sq mm		Effective Filter Area 855 sq mm	
Volume (liters)	# of grid openings	Volume (liters)	# of grid openings
560	24	1,250	24
600	23	1,300	23
700	19	1,400	21
800	17	1,600	19
900	15	1,800	17
1,000	14	2,000	15
1,100	12	2,200	14
1,200	11	2,400	13
1,300	10	2,800	12
1,400	10	2,600	11
1,500	9	3,000	10
1,600	8	3,200	9
1,700	8	3,400	9
1,800	8	3,600	8
1,900	7	3,800	8
2,000	7	4,000	8
2,100	6	4,200	7
2,200	6	4,400	7
2,300	6	4,600	7
2,400	6	4,800	6
2,500	5	5,000	6
2,600	5	5,200	6
2,700	5	5,400	6
2,800	5	5,600	5
2,900	5	5,800	5
3,000	5	6,000	5
3,100	4	6,200	5
3,200	4	6,400	5
3,300	4	6,600	5
3,400	4	6,800	4
3,500	4	7,000	4
3,600	4	7,200	4
3,700	4	7,400	4
3,800	4	7,600	4

Recommended Volume Range

Recommended Volume Range

Note minimum volumes required:
25 mm : 560 liters
37 mm : 1250 liters

Filter diameter of 25 mm = effective area of 385 sq mm
Filter diameter of 37 mm = effective area of 855 sq mm

20. Ensure that the sampler is turned upright before interrupting the pump flow.

21. Check that all samples are clearly labeled and that all pertinent information has been enclosed before transfer of the samples to the laboratory.

22. Ensure that the samples are stored in a secure and representative location.

23. Do not change containers if portions of these filters are taken for other purposes.

24. A summary of Sample Data Quality Objectives is shown in the following Table II:

TABLE II--SUMMARY OF SAMPLING AGENCY DATA QUALITY OBJECTIVES

This table summarizes the data quality objectives from the performance of this method in terms of precision, accuracy, completeness, representativeness, and comparability. These objectives are assured by the periodic control checks and reference checks listed here and described in the rest of the method.

Unit Operation	QC Check	Frequency	Conformance Expectation
Sampling materials	Sealed blank	1 per I/O site	95%
Sample procedures	Field blanks	2 per I/O site	95%
	Pump calibration	Before and after each field series	90%
Sample custody	Review of chain-of-custody record	Each sample	95% complete
Sample shipment	Review of sending report	Each sample	95% complete

C. Sample Shipment

Ship bulk samples to the analytical laboratory in a separate container from air samples.

D. Sample Receiving

1. Designate one individual as sample coordinator at the laboratory. While that individual will normally be available to receive samples, the coordinator may train and supervise others in receiving procedures for those times when he/she is not available.

2. Bulk samples and air samples delivered to the analytical laboratory in the same container shall be rejected.

E. Sample Preparation

1. All sample preparation and analysis shall be performed by a laboratory independent of the abatement contractor.

2. Wet-wipe the exterior of the cassettes to minimize contamination possibilities before taking them into the clean room facility.

3. Perform sample preparation in a well-equipped clean facility.

>Note: The clean area is required to have the following minimum characteristics. The area or hood must be capable of maintaining a positive pressure with make-up air being HEPA-filtered. The cumulative analytical blank concentration must average less than 18 s/mm ^{2} in an area of 0.057 mm ^{2} (nominally 10 200-mesh grid openings) and a single preparation with a maximum of 53 s/mm ^{2} for that same area.

4. Preparation areas for air samples must not only be separated from preparation areas for bulk samples, but they must be prepared in separate rooms.

5. Direct preparation techniques are required. The object is to produce an intact film containing the particulates of the filter surface which is sufficiently clear for TEM analysis.

a. TEM Grid Opening Area measurement must be done as follows:

i. The filter portion being used for sample preparation must have the surface collapsed using an acetone vapor technique.

ii. Measure 20 grid openings on each of 20 random 200-mesh copper grids by placing a grid on a glass and examining it under the PCM. Use a calibrated graticule to measure the average field diameters. From the data, calculate the field area for an average grid opening.

iii. Measurements can also be made on the TEM at a properly calibrated low magnification or on an optical microscope at a magnification of approximately 400X by using an eyepiece fitted with a scale that has been calibrated against a stage micrometer. Optical microscopy utilizing manual or automated procedures may be used providing instrument calibration can be verified.

b. TEM specimen preparation from polycarbonate (PC) filters. Procedures as described in Unit III.G. or other equivalent methods may be used.

c. TEM specimen preparation from mixed cellulose ester (MCE) filters.

i. Filter portion being used for sample preparation must have the surface collapsed using an acetone vapor technique or the Burdette procedure (Ref. 7 of Unit II.J.)

ii. Plasma etching of the collapsed filter is required. The microscope slide to which the collapsed filter pieces are attached is placed in a plasma asher. Because plasma ashers vary greatly in their performance, both from unit to unit and between different positions in the asher chamber, it is difficult to specify the conditions that should be used. Insufficient etching will result in a failure to expose embedded filters, and too much etching may result in loss of particulate from the surface. As an interim measure, it is recommended that the time for ashing of a known weight of a collapsed filter be established and that the etching rate be calculated in terms of micrometers per second. The actual etching time used for the particulate asher and operating conditions will then be set such that a 1-2 µm (10 percent) layer of collapsed surface will be removed.

iii. Procedures as described in Unit III. or other equivalent methods may be used to prepare samples.

F. TEM Method

1. An 80-120 kV TEM capable of performing electron diffraction with a fluorescent screen inscribed with calibrated gradations is required. If the TEM is equipped with EDXA it must either have a STEM attachment or be capable of producing a spot less than 250 nm in diameter at crossover. The microscope shall be calibrated routinely for magnification and camera constant.

2. *Determination of Camera Constant and ED Pattern Analysis.* The camera length of the TEM in ED operating mode must be calibrated before ED patterns on unknown samples are observed. This can be achieved by using a carbon-coated grid on which a thin film of gold has been sputtered or evaporated. A thin film of gold is evaporated on the specimen TEM grid to obtain zone-axis ED patterns superimposed with a ring pattern from the polycrystalline gold film. In practice, it is desirable to optimize the thickness of the gold film so that only one or two sharp rings are obtained on the superimposed ED pattern. Thicker gold film would normally give multiple gold rings, but it will tend to mask weaker diffraction spots from the unknown fibrous particulate. Since the unknown d-spacings of most interest in asbestos analysis are those which lie closest to the transmitted beam, multiple gold rings are unnecessary on zone-axis ED patterns. An average camera constant using multiple gold rings can be determined. The camera constant is one-half the diameter of the rings times the interplanar spacing of the ring being measured.

3. *Magnification Calibration.* The magnification calibration must be done at the fluorescent screen. The TEM must be calibrated at the grid opening magnification (if used) and also at the magnification used for fiber counting. This is performed with a cross grating replica (e.g., one containing 2,160 lines/mm). Define a field of view on the fluorescent screen either by markings or physical boundaries. The field of view must be measurable or previously inscribed with a scale or concentric circles (all scales should be metric). A logbook must be maintained, and the dates of calibration and the values obtained must be recorded. The frequency of calibration depends on the past history of the particular microscope. After any maintenance of the microscope that involved adjustment of the power supplied to the lenses or the high-voltage system or the mechanical disassembly of the electron optical column apart from filament exchange, the magnification must be recalibrated. Before the TEM calibration is performed, the analyst must ensure that the cross grating replica is placed at the same distance from the objective lens as the specimens are. For instruments that incorporate a eucentric tilting specimen stage, all specimens and the cross grating replica must be placed at the eucentric position.

4. While not required on every microscope in the laboratory, the laboratory must have either one microscope equipped with energy dispersive X-ray analysis or access to an equivalent system on a TEM in another laboratory.

5. Microscope settings: 80-120 kV, grid assessment 250-1,000X, then 15,000-20,000X screen magnification for analysis.

6. Approximately one-half (0.5) of the predetermined sample area to be analyzed shall be performed on one sample grid preparation and the remaining half on a second sample grid preparation.

7. Individual grid openings with greater than 5 percent openings (holes) or covered with greater than 25 percent particulate matter or obviously having nonuniform loading must not be analyzed.

8. Reject the grid if:

a. Less than 50 percent of the grid openings covered by the replica are intact.

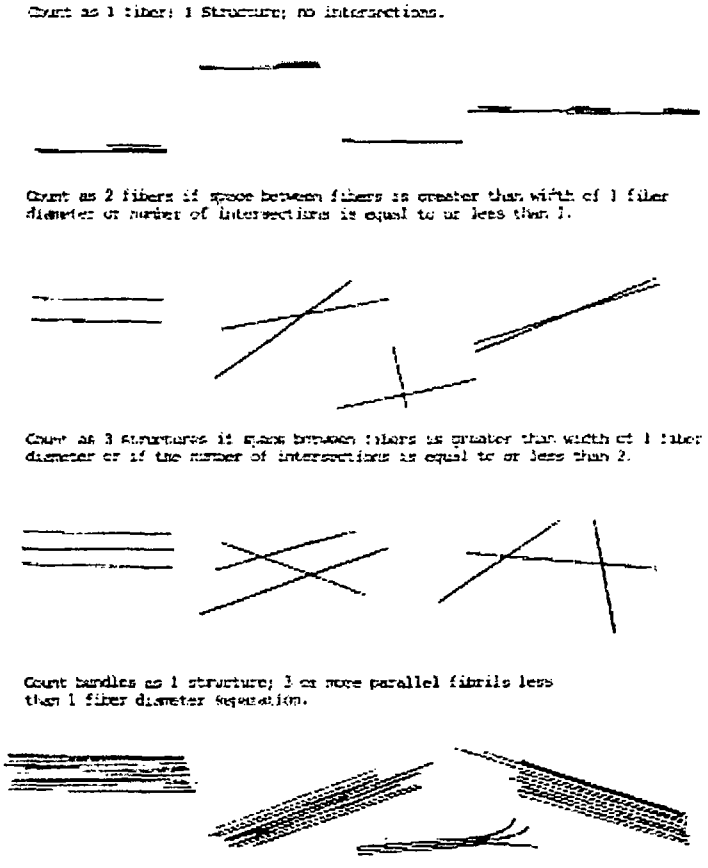
b. The replica is doubled or folded.

c. The replica is too dark because of incomplete dissolution of the filter.

9. *Recording Rules.*

a. Any continuous grouping of particles in which an asbestos fiber with an aspect ratio greater than or equal to 5:1 and a length greater than or equal to 0.5 µm is detected shall be recorded on the count sheet. These will be designated asbestos structures and will be classified as fibers, bundles, clusters, or matrices. Record as individual fibers any contiguous grouping having 0, 1, or 2 definable intersections. Groupings having more than 2 intersections are to be described as cluster or matrix. An intersection is a nonparallel touching or crossing of fibers, with the projection having an aspect ratio of 5:1 or greater. See the following Figure 2:

FIGURE 2--COUNTING GUIDELINES USED IN DETERMINING ASBESTOS STRUCTURES



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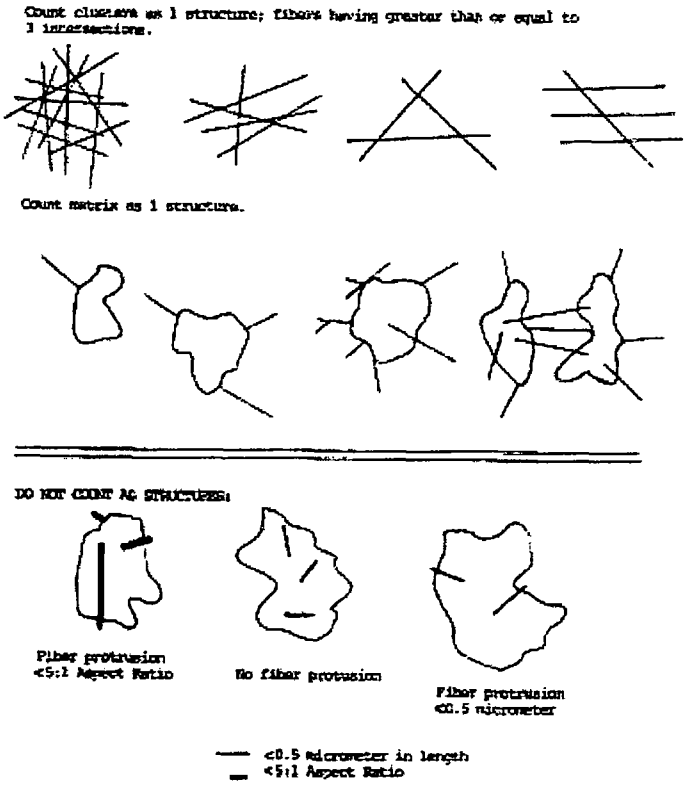

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i. *Fiber.* A structure having a minimum length greater than or equal to 0.5 µm and an aspect ratio (length to width) of 5:1 or greater and substantially parallel sides. Note the appearance of the end of the fiber, i.e., whether it is flat, rounded or dovetailed.

ii. *Bundle.* A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

iii. *Cluster.* A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

iv. *Matrix.* Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

b. Separate categories will be maintained for fibers less than 5 µm and for fibers equal to or greater than 5 µm in length.

c. Record NSD when no structures are detected in the field.

d. Visual identification of electron diffraction (ED) patterns is required for each asbestos structure counted which would cause the analysis to exceed the 70 s/mm ^{2} concentration. (Generally this means the first four fibers identified as asbestos must exhibit an identifiable diffraction pattern for chrysotile or amphibole.)

e. The micrograph number of the recorded diffraction patterns must be reported to the client and maintained in the laboratory's quality assurance records. In the event that examination of the pattern by a qualified individual indicates that the pattern has been misidentified visually, the client shall be contacted.

f. Energy Dispersive X-ray Analysis (EDXA) is required of all amphiboles which would cause the analysis results to exceed the 70 s/mm ^{2} concentration. (Generally speaking, the first 4

amphiboles would require EDXA.)

g. If the number of fibers in the nonasbestos class would cause the analysis to exceed the 70 s/mm ^{2} concentration, the fact that they are not asbestos must be confirmed by EDXA or measurement of a zone axis diffraction pattern.

h. Fibers classified as chrysotile must be identified by diffraction or X-ray analysis and recorded on a count sheet. X-ray analysis alone can be used only after 70 s/mm ^{2} have been exceeded for a particular sample.

i. Fibers classified as amphiboles must be identified by X-ray analysis and electron diffraction and recorded on the count sheet. (X-ray analysis alone can be used only after 70 s/mm ^{2} have been exceeded for a particular sample.)

j. If a diffraction pattern was recorded on film, record the micrograph number on the count sheet.

k. If an electron diffraction was attempted but no pattern was observed, record N on the count sheet.

l. If an EDXA spectrum was attempted but not observed, record N on the count sheet.

m. If an X-ray analysis spectrum is stored, record the file and disk number on the count sheet.

10. Classification Rules.

a. *Fiber.* A structure having a minimum length greater than or equal to 0.5 µm and an aspect ratio (length to width) of 5:1 or greater and substantially parallel sides. Note the appearance of the end of the fiber, i.e., whether it is flat, rounded or dovetailed.

b. *Bundle.* A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

c. *Cluster.* A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

d. *Matrix.* Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

11. After finishing with a grid, remove it from the microscope, and replace it in the appropriate grid holder. Sample grids must be stored for a minimum of 1 year from the date of the analysis; the sample cassette must be retained for a minimum of 30 days by the laboratory or returned at the client's request.

G. Sample Analytical Sequence

1. Under the present sampling requirements a minimum of 13 samples is to be collected for the clearance testing of an abatement site. These include five abatement area samples, five ambient samples, two field blanks, and one sealed blank.

2. Carry out visual inspection of work site prior to air monitoring.

3. Collect a minimum of 5 air samples inside the work site and 5 samples outside the work site. The indoor and outdoor samples shall be taken during the same time period.

4. Remaining steps in the analytical sequence are contained in Unit IV of this Appendix.

H. Reporting

1. The following information must be reported to the client for each sample analyzed:

a. Concentration in structures per square millimeter and structures per cubic centimeter.

b. Analytical sensitivity used for the analysis.

c. Number of asbestos structures.

d. Area analyzed.

e. Volume of air sampled (which must be initially supplied to lab by client).

f. Copy of the count sheet must be included with the report.

g. Signature of laboratory official to indicate that the laboratory met specifications of the method.

h. Report form must contain official laboratory identification (e.g., letterhead).

i. Type of asbestos.

I. Quality Control/Quality Assurance Procedures (Data Quality Indicators)

Monitoring the environment for airborne asbestos requires the use of sensitive sampling and analysis procedures. Because the test is sensitive, it may be influenced by a variety of factors. These include the supplies used in the sampling operation, the performance of the sampling, the preparation of the grid from the filter and the actual examination of this grid in the microscope. Each of these unit operations must produce a product of defined quality if the analytical result is to be a reliable and meaningful test result. Accordingly, a series of control checks and reference standards are to be performed along with the sample analysis as indicators that the materials used are adequate and the operations are within acceptable limits. In this way, the quality of the data is defined and the results are of known value. These checks and tests also provide timely and specific warning of any problems which might develop within the sampling and analysis operations. A description of these quality control/quality assurance procedures is summarized in the following Table III:

TABLE III--SUMMARY OF LABORATORY DATA QUALITY OBJECTIVES

Unit Operation	QC Check	Frequency	Conformance Expectation
Sample receiving	Review of receiving report	Each sample	95% complete
Sample custody	Review of chain-of-custody record	Each sample	95% complete
Sample preparation	Supplies and reagents	On receipt	Meet specs. or reject
	Grid opening size	20 openings/20 grids/lot of 1000 or 1 opening/sample	100%
	Special clean area monitoring	After cleaning or service	Meet specs. or reclean
	Laboratory blank	1 per prep series or 10%	Meet specs. or reanalyze series
	Plasma etch blank	1 per 20 samples	25%
	Multiple preps (3 per samples)	Each sample	One with covers of 85 complete grid sqs.
Sample analysis	System check	Each day	Each day
	Alignment check	Each day	Each day
	Magnification calibration with low and high standards	Each month or after service	95%
	ED calibration by gold standard	Weekly	95%
	EDS calibration by copper line	Daily	95%
Performance check	Laboratory blank (measure of cleanliness)	Prep 1 per series or 10% read 1 per 25 samples	Meet specs or reanalyze series
	Replicate counting (measure of precision)	1 per 100 samples	1.5 x Poisson Std. Dev.
	Duplicate analysis (measure of reproducibility)	1 per 100 samples	2 x Poisson Std. Dev.
	Known samples of typical materials (working standards)	Training and for comparison with unknowns	100%
	Analysis of NBS SRM 1876 and/or RM 8410 (measure of accuracy and comparability)	1 per analyst per year	1.5 x Poisson Std. Dev.
	Data entry review (data validation and measure of completeness)	Each sample	95%
	Record and verify ED electron diffraction pattern of structure	1 per 5 samples	80% accuracy
Calculations and data reduction	Hand calculation of automated data reduction procedure or independent recalculation of hand calculated data	1 per 100 samples	85%

1. When the samples arrive at the laboratory, check the samples and documentation for completeness and requirements before initiating the analysis.

2. Check all laboratory reagents and supplies for acceptable asbestos background levels.

3. Conduct all sample preparation in a clean room environment monitored by laboratory blanks. Testing with blanks must also be done after cleaning or servicing the room.

4. Prepare multiple grids of each sample.

5. Provide laboratory blanks with each sample batch. Maintain a cumulative average of these results. If there are more than 53 fibers/mm ^{2} per 10 200-mesh grid openings, the system must be checked for possible sources of contamination.

6. Perform a system check on the transmission electron microscope daily.

7. Make periodic performance checks of magnification, electron diffraction and energy dispersive X-ray systems as set forth in Table III under Unit II.I.

8. Ensure qualified operator performance by evaluation of replicate analysis and standard sample comparisons as set forth in Table III under Unit II.I.

9. Validate all data entries.

10. Recalculate a percentage of all computations and automatic data reduction steps as specified in Table III under Unit II.I.

11. Record an electron diffraction pattern of one asbestos structure from every five samples that contain asbestos. Verify the identification of the pattern by measurement or comparison of the pattern with patterns collected from standards under the same conditions. The records must also demonstrate that the identification of the pattern has been verified by a qualified individual and that the operator who made the identification is maintaining at least an 80 percent correct visual identification based on his measured patterns.

12. Appropriate logs or records must be maintained by the analytical laboratory verifying that it is in compliance with the mandatory quality assurance procedures.

J. References

For additional background information on this method, the following references should be consulted.

1. "Guidance for Controlling Asbestos-Containing Materials in Buildings," EPA 560/5-85-024, June 1985.

2. "Measuring Airborne Asbestos Following an Abatement Action," USEPA, Office of Pollution Prevention and Toxics, EPA 600/4-85-049, 1985.

3. Small, John and E. Steel. Asbestos Standards: Materials and Analytical Methods. N.B.S. Special Publication 619, 1982.

4. Campbell, W.J., R.L. Blake, L.L. Brown, E.E. Cather, and J.J. Sjoberg. Selected Silicate Minerals and Their Asbestiform Varieties. Information Circular 8751, U.S. Bureau of Mines, 1977.

5. Quality Assurance Handbook for Air Pollution Measurement System. Ambient Air Methods, EPA 600/4-77-027a, USEPA, Office of Research and Development, 1977.

6. Method 2A: Direct Measurement of Gas Volume through Pipes and Small Ducts. 40 CFR Part 60 Appendix A.

7. Burdette, G.J., Health & Safety Exec. Research & Lab. Services Div., London, "Proposed Analytical Method for Determination of Asbestos in Air."

8. Chatfield, E.J., Chatfield Tech. Cons., Ltd., Clark, T., PEI Assoc., "Standard Operating Procedure for Determination of Airborne Asbestos Fibers by Transmission Electron Microscopy Using Polycarbonate Membrane Filters," WERL SOP 87-1, March 5, 1987.

9. NIOSH Method 7402 for Asbestos Fibers, 12-11-86 Draft.

10. Yamate, G., Agarwall, S.C., Gibbons, R.D., IIT Research Institute, "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy," Draft report, USEPA Contract 68-02-3266, July 1984.

11. "Guidance to the Preparation of Quality Assurance Project Plans," USEPA, Office of Pollution Prevention and Toxics, 1984.

III. Nonmandatory Transmission Electron Microscopy Method

A. Definitions of Terms

1. *Analytical sensitivity* -- Airborne asbestos concentration represented by each fiber counted under the electron microscope. It is determined by the air volume collected and the proportion of the filter examined. This method requires that the analytical sensitivity be no greater than 0.005 s/cm ^{3}.

2. *Asbestiform* -- A specific type of mineral fibrosity in which the fibers and fibrils possess high tensile strength and flexibility.

3. *Aspect ratio* -- A ratio of the length to the width of a particle. Minimum aspect ratio as defined by this method is equal to or greater than 5:1.

4. *Bundle* -- A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

5. *Clean area* -- A controlled environment which is maintained and monitored to assure a low probability of asbestos contamination to materials in that space. Clean areas used in this method have HEPA filtered air under positive pressure and are capable of sustained operation with an open laboratory blank which on subsequent analysis has an average of less than 18 structures/mm ^{2} in an area of 0.057 mm ^{2} (nominally 10 200 mesh grid openings) and a maximum of 53 structures/mm ^{2} for no more than one single preparation for that same area.

6. *Cluster* -- A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

7. *ED* -- Electron diffraction.

8. *EDXA* -- Energy dispersive X-ray analysis.

9. *Fiber* -- A structure greater than or equal to 0.5 µm in length with an aspect ratio (length to width) of 5:1 or greater and having substantially parallel sides.

10. *Grid* -- An open structure for mounting on the sample to aid in its examination in the TEM. The term is used here to denote a 200-mesh copper lattice approximately 3 mm in diameter.

11. *Intersection* -- Nonparallel touching or crossing of fibers, with the projection having an aspect ratio of 5:1 or greater.

12. *Laboratory sample coordinator* -- That person responsible for the conduct of sample handling and the certification of the testing procedures.

13. *Filter background level* -- The concentration of structures per square millimeter of filter that is considered indistinguishable from the concentration measured on blanks (filters through which no air has been drawn). For this method the filter background level is defined as 70 structures/mm ^{2}.

14. *Matrix* -- Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

15. *NSD* -- No structure detected.

16. *Operator* -- A person responsible for the TEM instrumental analysis of the sample.

17. *PCM* -- Phase contrast microscopy.

18. *SAED* -- Selected area electron diffraction.

19. *SEM* -- Scanning electron microscope.

20. *STEM* -- Scanning transmission electron microscope.

21. *Structure* -- a microscopic bundle, cluster, fiber, or matrix which may contain asbestos.

22. *S/cm 3* -- Structures per cubic centimeter.

23. *S/mm 2* -- Structures per square millimeter.

24. *TEM* -- Transmission electron microscope.

B. Sampling

1. Sampling operations must be performed by qualified individuals completely independent of the abatement contractor to avoid possible conflict of interest (See References 1, 2, and 5 of Unit III.L.) Special precautions should be taken to avoid contamination of the sample. For example, materials that have not been prescreened for their asbestos background content should not be used; also, sample handling procedures which do not take cross contamination possibilities into account should not be used.

2. Material and supply checks for asbestos contamination should be made on all critical supplies, reagents, and procedures before their use in a monitoring study.

3. Quality control and quality assurance steps are needed to identify problem areas and isolate the cause of the contamination (see Reference 5 of Unit III.L.). Control checks shall be permanently recorded to document the quality of the information produced. The sampling firm must have written quality control procedures and documents which verify compliance. Independent audits by a qualified consultant or firm should be performed once a year. All documentation of compliance should be retained indefinitely to provide a guarantee of quality. A summary of Sample Data Quality Objectives is shown in Table II of Unit II.B.

4. Sampling materials.

a. Sample for airborne asbestos following an abatement action using commercially available cassettes.

b. Use either a cowling or a filter-retaining middle piece. Conductive material may reduce the potential for particulates to adhere to the walls of the cowl.

c. Cassettes must be verified as "clean" prior to use in the field. If packaged filters are used for loading or preloaded cassettes are purchased from the manufacturer or a distributor, the manufacturer's name and lot number should be entered on all field data sheets provided to the laboratory, and are required to be listed on all reports from the laboratory.

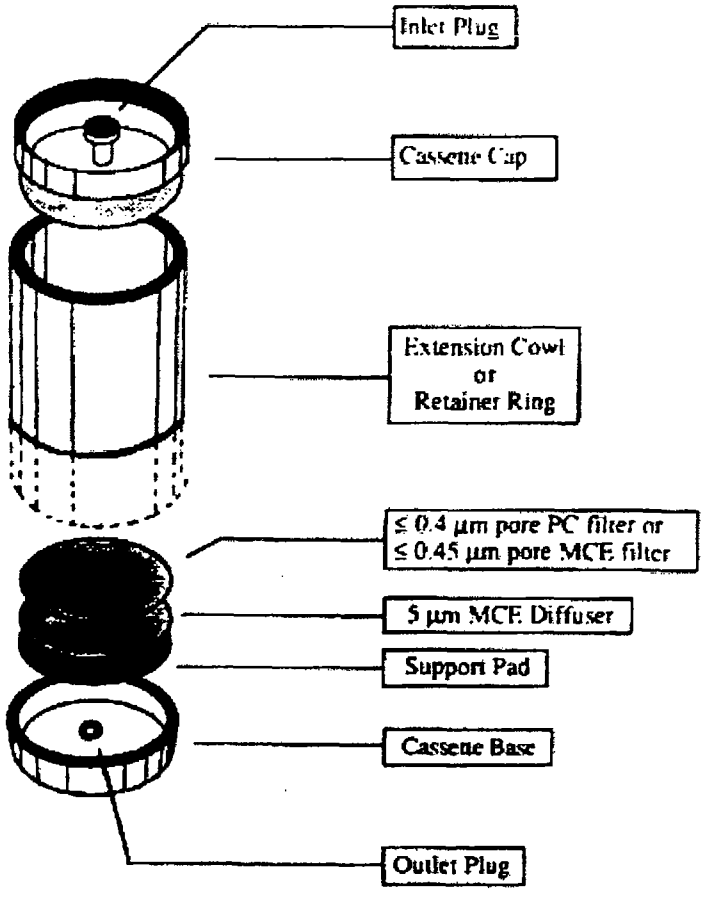
d. Assemble the cassettes in a clean facility (See definition of clean area under Unit III.A.).

e. Reloading of used cassettes is not permitted.

f. Use sample collection filters which are either polycarbonate having a pore size of less than or equal to 0.4 µm or mixed cellulose ester having a pore size of less than or equal to 0.45 µm.

g. Place these filters in series with a backup filter with a pore size of 5.0 µm (to serve as a diffuser) and a support pad. See the following Figure 1:

FIGURE I--SAMPLING CASSETTE CONFIGURATION



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h. When polycarbonate filters are used, position the highly reflective face such that the incoming particulate is received on this surface.

i. Seal the cassettes to prevent leakage around the filter edges or between cassette part joints. A mechanical press may be useful to achieve a reproducible leak-free seal. Shrink fit gel-bands may be used for this purpose and are available from filter manufacturers and their authorized distributors.

j. Use wrinkle-free loaded cassettes in the sampling operation.

5. Pump setup.

a. Calibrate the sampling pump over the range of flow rates and loads anticipated for the monitoring period with this flow measuring device in series. Perform this calibration using guidance from EPA Method 2A each time the unit is sent to the field (See Reference 6 of Unit III.L.).

b. Configure the sampling system to preclude pump vibrations from being transmitted to the cassette by using a sampling stand separate from the pump station and making connections with flexible tubing.

c. Maintain continuous smooth flow conditions by damping out any pump action fluctuations if necessary.

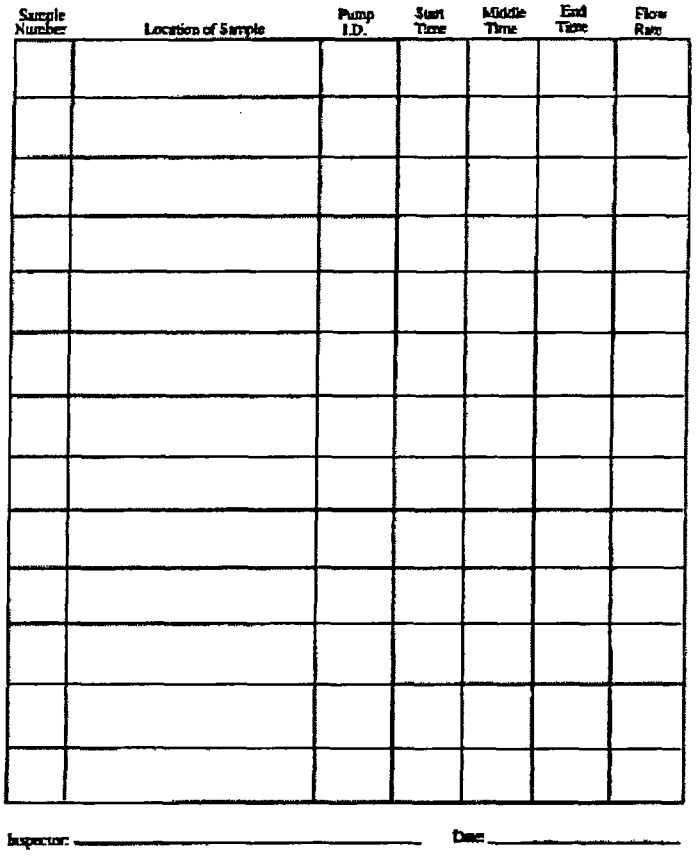
d. Check the sampling system for leaks with the end cap still in place and the pump operating before initiating sample collection. Trace and stop the source of any flow indicated by the flowmeter under these conditions.

e. Select an appropriate flow rate equal to or greater than 1 L/min or less than 10 L/min for 25 mm cassettes. Larger filters may be operated at proportionally higher flow rates.

f. Orient the cassette downward at approximately 45 degrees from the horizontal.

g. Maintain a log of all pertinent sampling information, such as pump identification number, calibration data, sample location, date, sample identification number, flow rates at the beginning, middle, and end, start and stop times, and other useful information or comments. Use of a sampling log form is recommended. See the following Figure 2:

FIGURE 2--SAMPLING LOG FORM



Sample Number	Location of Sample	Pump I.D.	Start Time	Middle Time	End Time	Flow Rate

Inspector: _____ Date: _____

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h. Initiate a chain of custody procedure at the start of each sampling, if this is requested by the client.

i. Maintain a close check of all aspects of the sampling operation on a regular basis.

j. Continue sampling until at least the minimum volume is collected, as specified in the following Table I:

TABLE 1--NUMBER OF 200 MESH EM GRID OPENINGS (0.0057 MM^2) THAT NEED TO BE ANALYZED TO MAINTAIN SENSITIVITY OF 0.005 STRUCTURES/CC BASED ON VOLUME AND EFFECTIVE FILTER AREA

Effective Filter Area 385 sq mm		Effective Filter Area 855 sq mm	
Volume (liters)	# of grid openings	Volume (liters)	# of grid openings
560	24	1,250	24
600	23	1,300	23
700	19	1,400	21
800	17	1,500	19
900	15	1,800	17
1,000	14	2,000	15
1,100	12	2,200	14
1,200	11	2,400	13
1,300	10	2,600	12
1,400	10	2,800	11
1,500	9	3,000	10
1,600	8	3,200	9
1,700	8	3,400	9
1,800	8	3,600	8
1,900	7	3,800	8
2,000	7	4,000	8
2,100	6	4,200	7
2,200	6	4,400	7
2,300	6	4,600	7
2,400	6	4,800	6
2,500	5	5,000	6
2,600	5	5,200	6
2,700	5	5,400	6
2,800	5	5,600	6
2,900	5	5,800	5
3,000	5	6,000	5
3,100	4	6,200	5
3,200	4	6,400	5
3,300	4	6,600	5
3,400	4	6,800	4
3,500	4	7,000	4
3,600	4	7,200	4
3,700	4	7,400	4
3,800	4	7,600	4

Recommended Volume Range

Recommended Volume Range

Note minimum volumes required:
25 mm : 560 liters
37 mm : 1250 liters

Filter diameter of 25 mm = effective area of 385 sq mm
Filter diameter of 37 mm = effective area of 855 sq mm

k. At the conclusion of sampling, turn the cassette upward before stopping the flow to minimize possible particle loss. If the sampling is resumed, restart the flow before reorienting the cassette downward. Note the condition of the filter at the conclusion of sampling.

l. Double check to see that all information has been recorded on the data collection forms and that the cassette is securely closed and appropriately identified using a waterproof label. Protect cassettes in individual clean resealed polyethylene bags. Bags are to be used for storing cassette caps when they are removed for sampling purposes. Caps and plugs should only be removed or replaced using clean hands or clean disposable plastic gloves.

m. Do not change containers if portions of these filters are taken for other purposes.

6. Minimum sample number per site. A minimum of 13 samples are to be collected for each testing consisting of the following:

a. A minimum of five samples per abatement area.

b. A minimum of five samples per ambient area positioned at locations representative of the air entering the abatement site.

c. Two field blanks are to be taken by removing the cap for not more than 30 sec and replacing it at the time of sampling before sampling is initiated at the following places:

i. Near the entrance to each ambient area.

ii. At one of the ambient sites.

(Note: Do not leave the blank open during the sampling period.)

d. A sealed blank is to be carried with each sample set. This representative cassette is not to be opened in the field.

7. Abatement area sampling.

a. Conduct final clearance sampling only after the primary containment barriers have been removed; the abatement area has been thoroughly dried; and, it has passed visual inspection tests by qualified personnel. (See Reference 1 of Unit III.L.)

b. Containment barriers over windows, doors, and air passageways must remain in place until the TEM clearance sampling and analysis is completed and results meet clearance test criteria. The final plastic barrier remains in place for the sampling period.

c. Select sampling sites in the abatement area on a random basis to provide unbiased and representative samples.

d. After the area has passed a thorough visual inspection, use aggressive sampling conditions to dislodge any remaining dust.

i. Equipment used in aggressive sampling such as a leaf blower and/or fan should be properly cleaned and decontaminated before use.

ii. Air filtration units shall remain on during the air monitoring period.

iii. Prior to air monitoring, floors, ceiling and walls shall be swept with the exhaust of a minimum one (1) horsepower leaf blower.

iv. Stationary fans are placed in locations which will not interfere with air monitoring equipment. Fan air is directed toward the ceiling. One fan shall be used for each 10,000 ft^3 of worksite.

v. Monitoring of an abatement work area with high-volume pumps and the use of circulating fans will require electrical power. Electrical outlets in the abatement area may be used if available. If no such outlets are available, the equipment must be supplied with electricity by the use of extension cords and strip plug units. All electrical power supply equipment of this type must be approved Underwriter Laboratory equipment that has not been modified. All wiring must be grounded. Ground fault interrupters should be used. Extreme care must be taken to clean up any residual water and ensure that electrical equipment does not become wet while operational.

vi. Low volume pumps may be carefully wrapped in 6-mil polyethylene to insulate the pump from the air. High volume pumps cannot be sealed in this manner since the heat of the motor may melt the plastic. The pump exhausts should be kept free.

vii. If recleaning is necessary, removal of this equipment from the work area must be handled with care. It is not possible to completely decontaminate the pump motor and parts since these areas cannot be wetted. To minimize any problems in this area, all equipment such as fans and pumps should be carefully wet wiped prior to removal from the abatement area. Wrapping and sealing low volume pumps in 6-mil polyethylene will provide easier decontamination of this equipment. Use of clean water and disposable wipes should be available for this purpose.

e. Pump flow rate equal to or greater than 1 L/min or less than 10 L/min may be used for 25 mm cassettes. The larger cassette diameters may have comparably increased flow.

f. Sample a volume of air sufficient to ensure the minimum quantitation limits. (See Table I of Unit III.B.5.j.)

8. Ambient sampling.

a. Position ambient samplers at locations representative of the air entering the abatement site. If makeup air entering the abatement site is drawn from another area of the building which is outside of the abatement area, place the pumps in the building, pumps should be placed out of

doors located near the building and away from any obstructions that may influence wind patterns. If construction is in progress immediately outside the enclosure, it may be necessary to select another ambient site. Samples should be representative of any air entering the work site.

b. Locate the ambient samplers at least 3 ft apart and protect them from adverse weather conditions.

c. Sample same volume of air as samples taken inside the abatement site.

C. Sample Shipment

1. Ship bulk samples in a separate container from air samples. Bulk samples and air samples delivered to the analytical laboratory in the same container shall be rejected.

2. Select a rigid shipping container and pack the cassettes upright in a noncontaminating nonfibrous medium such as a bubble pack. The use of resealable polyethylene bags may help to prevent jostling of individual cassettes.

3. Avoid using expanded polystyrene because of its static charge potential. Also avoid using particle-based packaging materials because of possible contamination.

4. Include a shipping bill and a detailed listing of samples shipped, their descriptions and all identifying numbers or marks, sampling data, shipper's name, and contact information. For each sample set, designate which are the ambient samples, which are the abatement area samples, which are the field blanks, and which is the sealed blank if sequential analysis is to be performed.

5. Hand-carry samples to the laboratory in an upright position if possible; otherwise choose that mode of transportation least likely to jar the samples in transit.

6. Address the package to the laboratory sample coordinator by name when known and alert him or her of the package description, shipment mode, and anticipated arrival as part of the chain of custody and sample tracking procedures. This will also help the laboratory schedule timely analysis for the samples when they are received.

D. Quality Control/Quality Assurance Procedures (Data Quality Indicators)

Monitoring the environment for airborne asbestos requires the use of sensitive sampling and analysis procedures. Because the test is sensitive, it may be influenced by a variety of factors. These include the supplies used in the sampling operation, the performance of the sampling, the preparation of the grid from the filter and the actual examination of this grid in the microscope. Each of these unit operations must produce a product of defined quality if the analytical result is to be a reliable and meaningful test result. Accordingly, a series of control checks and reference standards is performed along with the sample analysis as indicators that the materials used are adequate and the operations are within acceptable limits. In this way, the quality of the data is defined, and the results are of known value. These checks and tests also provide timely and specific warning of any problems which might develop within the sampling and analysis operations. A description of these quality control/quality assurance procedures is summarized in the text below.

1. Prescreen the loaded cassette collection filters to assure that they do not contain concentrations of asbestos which may interfere with the analysis of the sample. A filter blank average of less than 18 s/mm ^{2} in an area of 0.057 mm ^{2} (nominally 10 200-mesh grid openings) and a maximum of 53 s/mm ^{2} for that same area for any single preparation is acceptable for this method.

2. Calibrate sampling pumps and their flow indicators over the range of their intended use with a recognized standard. Assemble the sampling system with a representative filter -- not the filter which will be used in sampling -- before and after the sampling operation.

3. Record all calibration information with the data to be used on a standard sampling form.

4. Ensure that the samples are stored in a secure and representative location.

5. Ensure that mechanical calibrations from the pump will be minimized to prevent transferral of vibration to the cassette.

6. Ensure that a continuous smooth flow of negative pressure is delivered by the pump by installing a damping chamber if necessary.

7. Open a loaded cassette momentarily at one of the indoor sampling sites when sampling is initiated. This sample will serve as an indoor field blank.

8. Open a loaded cassette momentarily at one of the outdoor sampling sites when sampling is initiated. This sample will serve as an outdoor field blank.

9. Carry a sealed blank into the field with each sample series. Do not open this cassette in the field.

10. Perform a leak check of the sampling system at each indoor and outdoor sampling site by activating the pump with the closed sampling cassette in line. Any flow indicates a leak which must be eliminated before initiating the sampling operation.

11. Ensure that the sampler is turned upright before interrupting the pump flow.

12. Check that all samples are clearly labeled and that all pertinent information has been enclosed before transfer of the samples to the laboratory.

E. Sample Receiving

1. Designate one individual as sample coordinator at the laboratory. While that individual will normally be available to receive samples, the coordinator may train and supervise others in receiving procedures for those times when he/she is not available.

2. Adhere to the following procedures to ensure both the continued chain-of-custody and the accountability of all samples passing through the laboratory:

a. Note the condition of the shipping package and data written on it upon receipt.

b. Retain all bills of lading or shipping slips to document the shipper and delivery time.

c. Examine the chain-of-custody seal, if any, and the package for its integrity.

d. If there has been a break in the seal or substantive damage to the package, the sample coordinator shall immediately notify the shipper and a responsible laboratory manager before any action is taken to unpack the shipment.

e. Packages with significant damage shall be accepted only by the responsible laboratory manager after discussions with the client.

3. Unwrap the shipment in a clean, uncluttered facility. The sample coordinator or his or her designee will record the contents, including a description of each item and all identifying numbers or marks. A Sample Receiving Form to document this information is attached for use when necessary. (See the following Figure 3.)

FIGURE 3--SAMPLE RECEIVING FORM

Date of package delivery _____ Package shipped from _____

Carrier _____ Shipping bill retained _____

*Condition of package on receipt _____

*Condition of custody seal _____

Number of samples received _____ Shipping manifest attached _____

Purchase Order No. _____ Project I.D. _____

Comments _____

No.	Description	Sampling Medium PC	Sampling Medium MCE	Sample Volume Liters	Receiving Init.	Assigned #
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						

(Use as many additional sheets as needed.)

Comments _____

Date of acceptance into sample bank _____

Signature of chain-of-custody recipient _____

Disposition of samples _____

*Note: If the package has sustained substantial damage or the custody seal is broken, stop and contact the project manager and the shipper.

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Note: The person breaking the chain-of-custody seal and itemizing the contents assumes responsibility for the shipment and signs documents accordingly.

4. Assign a laboratory number and schedule an analysis sequence.

5. Manage all chain-of-custody samples within the laboratory such that their integrity can be ensured and documented.

F. Sample Preparation

1. Personnel not affiliated with the Abatement Contractor shall be used to prepare samples and conduct TEM analysis. Wet-wipe the exterior of the cassettes to minimize contamination possibilities before taking them to the clean sample preparation facility.

2. Perform sample preparation in a well-equipped clean facility.

Note: The clean area is required to have the following minimum characteristics. The area or hood must be capable of maintaining a positive pressure with make-up air being HEPA filtered. The cumulative analytical blank concentration must average less than 18 s/mm ^{2} in an area of 0.057 s/mm ^{2} (nominally 10 200-mesh grid openings) with no more than one single preparation to exceed 53 s/mm ^{2} for that same area.

3. Preparation areas for air samples must be separated from preparation areas for bulk samples. Personnel must not prepare air samples if they have previously been preparing bulk

samples without performing appropriate personal hygiene procedures, i.e., clothing change, showering, etc.

4. *Preparation.* Direct preparation techniques are required. The objective is to produce an intact carbon film containing the particulates from the filter surface which is sufficiently clear for TEM analysis. Currently recommended direct preparation procedures for polycarbonate (PC) and mixed cellulose ester (MCE) filters are described in Unit III.F.7. and 8. Sample preparation is a subject requiring additional research. Variation on those steps which do not substantively change the procedure, which improve filter clearing or which reduce contamination problems in a laboratory are permitted.

a. Use only TEM grids that have had grid opening areas measured according to directions in Unit III.J.

b. Remove the inlet and outlet plugs prior to opening the cassette to minimize any pressure differential that may be present.

c. Examples of techniques used to prepare polycarbonate filters are described in Unit III.F.7.

d. Examples of techniques used to prepare mixed cellulose ester filters are described in Unit III.F.8.

e. Prepare multiple grids for each sample.

f. Store the three grids to be measured in appropriately labeled grid holders or polyethylene capsules.

5. Equipment.

a. Clean area.

b. Tweezers. Fine-point tweezers for handling of filters and TEM grids.

c. Scalpel Holder and Curved No. 10 Surgical Blades.

d. Microscope slides.

e. Double-coated adhesive tape.

f. Gummed page reinforcements.

g. Micro-pipet with disposal tips 10 to 100 µL variable volume.

h. Vacuum coating unit with facilities for evaporation of carbon. Use of a liquid nitrogen cold trap above the diffusion pump will minimize the possibility of contamination of the filter surface by oil from the pumping system. The vacuum-coating unit can also be used for deposition of a thin film of gold.

i. *Carbon rod electrodes.* Spectrochemically pure carbon rods are required for use in the vacuum evaporator for carbon coating of filters.

j. *Carbon rod sharpener.* This is used to sharpen carbon rods to a neck. The use of necked carbon rods (or equivalent) allows the carbon to be applied to the filters with a minimum of heating.

k. *Low-temperature plasma asher.* This is used to etch the surface of collapsed mixed cellulose ester (MCE) filters. The asher should be supplied with oxygen, and should be modified as necessary to provide a throttle or bleed valve to control the speed of the vacuum to minimize

disturbance of the filter. Some early models of ashers admit air too rapidly, which may disturb particulates on the surface of the filter during the etching step.

l. *Glass petri dishes, 10 cm in diameter, 1 cm high.* For prevention of excessive evaporation of solvent when these are in use, a good seal must be provided between the base and the lid. The seal can be improved by grinding the base and lid together with an abrasive grinding material.

m. Stainless steel mesh.

n. Lens tissue.

o. Copper 200-mesh TEM grids, 3 mm in diameter, or equivalent.

p. Gold 200-mesh TEM grids, 3 mm in diameter, or equivalent.

q. Condensation washer.

r. Carbon-coated, 200-mesh TEM grids, or equivalent.

s. Analytical balance, 0.1 mg sensitivity.

t. Filter paper, 9 cm in diameter.

u. Oven or slide warmer. Must be capable of maintaining a temperature of 65-70 °C.

v. Polyurethane foam, 6 mm thickness.

w. Gold wire for evaporation.

6. Reagents.

a. *General.* A supply of ultra-clean, fiber-free water must be available for washing of all components used in the analysis. Water that has been distilled in glass or filtered or deionized water is satisfactory for this purpose. Reagents must be fiber-free.

b. Polycarbonate preparation method -- chloroform.

c. Mixed Cellulose Ester (MCE) preparation method -- acetone or the Burdette procedure (Ref. 7 of Unit III.L.).

7. TEM specimen preparation from polycarbonate filters.

a. *Specimen preparation laboratory.* It is most important to ensure that contamination of TEM specimens by extraneous asbestos fibers is minimized during preparation.

b. Cleaning of sample cassettes. Upon receipt at the analytical laboratory and before they are taken into the clean facility or laminar flow hood, the sample cassettes must be cleaned of any contamination adhering to the outside surfaces.

c. Preparation of the carbon evaporator. If the polycarbonate filter has already been carbon-coated prior to receipt, the carbon coating step will be omitted, unless the analyst believes the carbon film is too thin. If there is a need to apply more carbon, the filter will be treated in the same way as an uncoated filter. Carbon coating must be performed with a high-vacuum coating unit. Units that are based on evaporation of carbon filaments in a vacuum generated only by an oil rotary pump have not been evaluated for this application, and must not be used. The carbon rods should be sharpened by a carbon rod sharpener to necks of about 4 mm long and 1 mm in diameter. The rods are installed in the evaporator in such a manner that the points are approximately 10 to 12 cm from the surface of a microscope slide held in the rotating and

tilting device.

d. Selection of filter area for carbon coating. Before preparation of the filters, a 75 mm×50 mm microscope slide is washed and dried. This slide is used to support strips of filter during the carbon evaporation. Two parallel strips of double-sided adhesive tape are applied along the length of the slide. Polycarbonate filters are easily stretched during handling, and cutting of areas for further preparation must be performed with great care. The filter and the MCE backing filter are removed together from the cassette and placed on a cleaned glass microscope slide. The filter can be cut with a curved scalpel blade by rocking the blade from the point placed in contact with the filter. The process can be repeated to cut a strip approximately 3 mm wide across the diameter of the filter. The strip of polycarbonate filter is separated from the corresponding strip of backing filter and carefully placed so that it bridges the gap between the adhesive tape strips on the microscope slide. The filter strip can be held with fine-point tweezers and supported underneath by the scalpel blade during placement on the microscope slide. The analyst can place several such strips on the same microscope slide, taking care to rinse and wet-wipe the scalpel blade and tweezers before handling a new sample. The filter strips should be identified by etching the glass slide or marking the slide using a marker insoluble in water and solvents. After the filter strip has been cut from each filter, the residual parts of the filter must be returned to the cassette and held in position by reassembly of the cassette. The cassette will then be archived for a period of 30 days or returned to the client upon request.

e. Carbon coating of filter strips. The glass slide holding the filter strips is placed on the rotation-tilting device, and the evaporator chamber is evacuated. The evaporation must be performed in very short bursts, separated by some seconds to allow the electrodes to cool. If evaporation is too rapid, the strips of polycarbonate filter will begin to curl, which will lead to cross-linking of the surface material and make it relatively insoluble in chloroform. An experienced analyst can judge the thickness of carbon film to be applied, and some test should be made first on unused filters. If the film is too thin, large particles will be lost from the TEM specimen, and there will be few complete and undamaged grid openings on the specimen. If the coating is too thick, the filter will tend to curl when exposed to chloroform vapor and the carbon film may not adhere to the support mesh. Too thick a carbon film will also lead to a TEM image that is lacking in contrast, and the ability to obtain ED patterns will be compromised. The carbon film should be as thin as possible and remain intact on most of the grid openings of the TEM specimen intact.

f. Preparation of the Jaffe washer. The precise design of the Jaffe washer is not considered important, so any one of the published designs may be used. A washer consisting of a simple stainless steel bridge is recommended. Several pieces of lens tissue approximately 1.0 cm×0.5 cm are placed on the stainless steel bridge, and the washer is filled with chloroform to a level where the meniscus contacts the underside of the mesh, which results in saturation of the lens tissue. See References 8 and 10 of Unit III.L.

g. Placing of specimens into the Jaffe washer. The TEM grids are first placed on a piece of lens tissue so that individual grids can be picked up with tweezers. Using a curved scalpel blade, the analyst excises three 3 mm square pieces of the carbon-coated polycarbonate filter from the filter strip. The three squares are selected from the center of the strip and from two points between the outer periphery of the active surface and the center. The piece of filter is placed on a TEM specimen grid with the shiny side of the TEM grid facing upwards, and the whole assembly is placed boldly onto the saturated lens tissue in the Jaffe washer. If carbon-coated grids are used, the filter should be placed carbon-coated side down. The three excised squares of filters are placed on the same piece of lens tissue. Any number of separate pieces of lens tissue may be placed in the same Jaffe washer. The lid is then placed on the Jaffe washer, and the system is allowed to stand for several hours, preferably overnight.

h. *Condensation washing.* It has been found that many polycarbonate filters will not dissolve completely in the Jaffe washer, even after being exposed to chloroform for as long as 3 days. This problem becomes more serious if the surface of the filter was overheated during the carbon evaporation. The presence of undissolved filter medium on the TEM preparation leads to partial or complete obscuration of areas of the sample, and fibers that may be present in these areas of the specimen will be overlooked; this will lead to a low result. Undissolved filter

medium also compromises the ability to obtain ED patterns. Before they are counted, TEM grids must be examined critically to determine whether they are adequately cleared of residual filter medium. It has been found that condensation washing of the grids after the initial Jaffe washer treatment, with chloroform as the solvent, clears all residual filter medium in a period of approximately 1 hour. In practice, the piece of lens tissue supporting the specimen grids is transferred to the cold finger of the condensation washer, and the washer is operated for about 1 hour. If the specimens are cleared satisfactorily by the Jaffe washer alone, the condensation washer step may be unnecessary.

8. TEM specimen preparation from MCE filters.

a. This method of preparing TEM specimens from MCE filters is similar to that specified in NIOSH Method 7402. See References 7, 8, and 9 of Unit III.L.

b. Upon receipt at the analytical laboratory, the sample cassettes must be cleaned of any contamination adhering to the outside surfaces before entering the clean sample preparation area.

c. Remove a section from any quadrant of the sample and blank filters.

d. Place the section on a clean microscope slide. Affix the filter section to the slide with a gummed paged reinforcement or other suitable means. Label the slide with a water and solvent-proof marking pen.

e. Place the slide in a petri dish which contains several paper filters soaked with 2 to 3 mL acetone. Cover the dish. Wait 2 to 4 minutes for the sample filter to fuse and clear.

f. Plasma etching of the collapsed filter is required.

i. The microscope slide to which the collapsed filter pieces are attached is placed in a plasma asher. Because plasma ashers vary greatly in their performance, both from unit to unit and between different positions in the asher chamber, it is difficult to specify the conditions that should be used. This is one area of the method that requires further evaluation. Insufficient etching will result in a failure to expose embedded filters, and too much etching may result in loss of particulate from the surface. As an interim measure, it is recommended that the time for ashing of a known weight of a collapsed filter be established and that the etching rate be calculated in terms of micrometers per second. The actual etching time used for a particular asher and operating conditions will then be set such that a 1-2 μm (10 percent) layer of collapsed surface will be removed.

ii. Place the slide containing the collapsed filters into a low-temperature plasma asher, and etch the filter.

g. Transfer the slide to a rotating stage inside the bell jar of a vacuum evaporator. Evaporate a 1 mm×5 mm section of graphite rod onto the cleared filter. Remove the slide to a clean, dry, covered petri dish.

h. Prepare a second petri dish as a Jaffe washer with the wicking substrate prepared from filter or lens paper placed on top of a 6 mm thick disk of clean spongy polyurethane foam. Cut a V-notch on the edge of the foam and filter paper. Use the V-notch as a reservoir for adding solvent. The wicking substrate should be thin enough to fit into the petri dish without touching the lid.

i. Place carbon-coated TEM grids face up on the filter or lens paper. Label the grids by marking with a pencil on the filter paper or by putting registration marks on the petri dish lid and marking with a waterproof marker on the dish lid. In a fume hood, fill the dish with acetone until the wicking substrate is saturated. The level of acetone should be just high enough to saturate the filter paper without creating puddles.

j. Remove about a quarter section of the carbon-coated filter samples from the glass slides using a surgical knife and tweezers. Carefully place the section of the filter, carbon side down, on the appropriately labeled grid in the acetone-saturated petri dish. When all filter sections have been transferred, slowly add more solvent to the wedge-shaped trough to bring the acetone level up to the highest possible level without disturbing the sample preparations. Cover the petri dish. Elevate one side of the petri dish by placing a slide under it. This allows drops of condensed solvent vapors to form near the edge rather than in the center where they would drip onto the grid preparation.

G. TEM Method

1. *Instrumentation.*

a. Use an 80-120 kV TEM capable of performing electron diffraction with a fluorescent screen inscribed with calibrated gradations. If the TEM is equipped with EDXA it must either have a STEM attachment or be capable of producing a spot less than 250 nm in diameter at crossover. The microscope shall be calibrated routinely (see Unit III.J.) for magnification and camera constant.

b. While not required on every microscope in the laboratory, the laboratory must have either one microscope equipped with energy dispersive X-ray analysis or access to an equivalent system on a TEM in another laboratory. This must be an Energy Dispersive X-ray Detector mounted on TEM column and associated hardware/software to collect, save, and read out spectral information. Calibration of Multi-Channel Analyzer shall be checked regularly for A1 at 1.48 KeV and Cu at 8.04 KeV, as well as the manufacturer's procedures.

i. Standard replica grating may be used to determine magnification (e.g., 2160 lines/mm).

ii. Gold standard may be used to determine camera constant.

c. Use a specimen holder with single tilt and/or double tilt capabilities.

2. Procedure.

a. Start a new Count Sheet for each sample to be analyzed. Record on count sheet: analyst's initials and date; lab sample number; client sample number microscope identification; magnification for analysis; number of predetermined grid openings to be analyzed; and grid identification. See the following Figure 4:

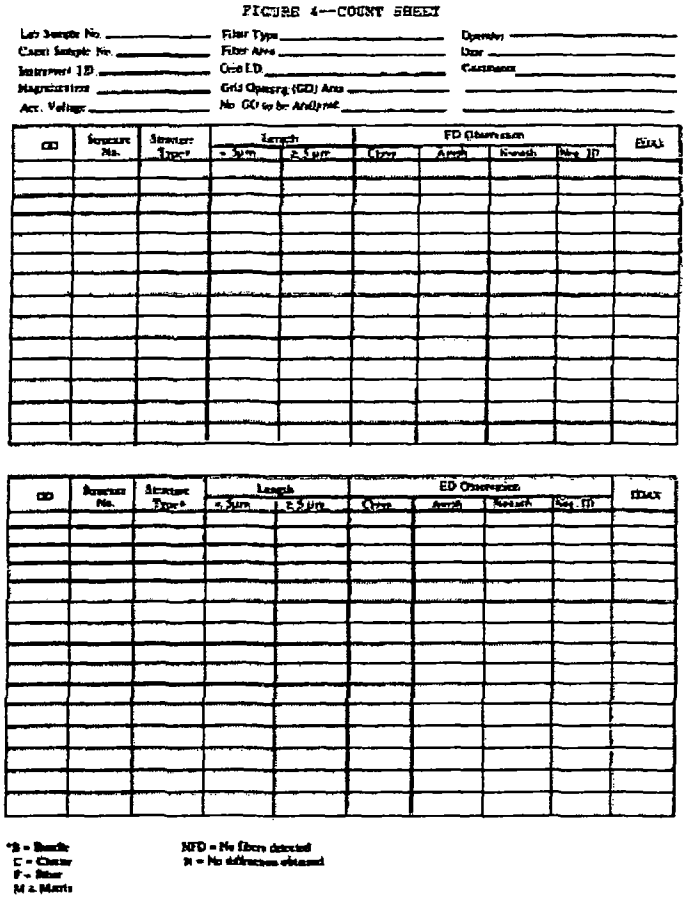

FIGURE 4--COUNT SHEET

Lab Sample No. _____ Filter Type _____ Operator _____
Client Sample No. _____ Filter Area _____ User _____
Instrument ID _____ Grid ID _____ Customer _____
Magnification _____ Grid Opening (GO) Area _____ _____
Acc. Voltage _____ No. GOs to be Analyzed _____ _____

GO	Structure No.	Structure Type*	Length		EDS Observation				Elem.
			≤ 5µm	≥ 5µm	Chrys	Amph	Nonasb.	Neg. ID	

GO	Structure No.	Structure Type*	Length		EDS Observation				Elem.
			≤ 5µm	≥ 5µm	Chrys	Amph	Nonasb.	Neg. ID	

*B = Bundle
C = Cluster
F = Fiber
M = Matrix

NFD = No fibers detected
N = No diffraction obtained

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b. Check that the microscope is properly aligned and calibrated according to the manufacturer's specifications and instructions.

c. Microscope settings: 80-120 kV, grid assessment 250-1000X, then 15,000-20,000X screen magnification for analysis.

d. Approximately one-half (0.5) of the predetermined sample area to be analyzed shall be performed on one sample grid preparation and the remaining half on a second sample grid preparation.

e. Determine the suitability of the grid.

i. Individual grid openings with greater than 5 percent openings (holes) or covered with greater than 25 percent particulate matter or obviously having nonuniform loading shall not be analyzed.

ii. Examine the grid at low magnification (<1000X) to determine its suitability for detailed study at higher magnifications.

iii. Reject the grid if:

(1) Less than 50 percent of the grid openings covered by the replica are intact.

(2) It is doubled or folded.

(3) It is too dark because of incomplete dissolution of the filter.

iv. If the grid is rejected, load the next sample grid.

v. If the grid is acceptable, continue on to Step 6 if mapping is to be used; otherwise proceed to Step 7.

f. Grid Map (Optional).

i. Set the TEM to the low magnification mode.

ii. Use flat edge or finder grids for mapping.

iii. Index the grid openings (fields) to be counted by marking the acceptable fields for one-half (0.5) of the area needed for analysis on each of the two grids to be analyzed. These may be marked just before examining each grid opening (field), if desired.

iv. Draw in any details which will allow the grid to be properly oriented if it is reloaded into the microscope and a particular field is to be reliably identified.

g. Scan the grid.

i. Select a field to start the examination.

ii. Choose the appropriate magnification (15,000 to 20,000X screen magnification).

iii. Scan the grid as follows.

(1) At the selected magnification, make a series of parallel traverses across the field. On reaching the end of one traverse, move the image one window and reverse the traverse.

Note: A slight overlap should be used so as not to miss any part of the grid opening (field).

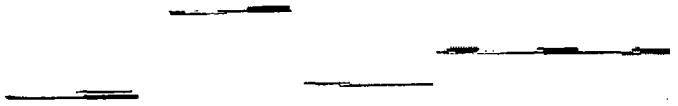
(2) Make parallel traverses until the entire grid opening (field) has been scanned.

h. Identify each structure for appearance and size.

i. Appearance and size: Any continuous grouping of particles in which an asbestos fiber within aspect ratio greater than or equal to 5:1 and a length greater than or equal to 0.5 µm is detected shall be recorded on the count sheet. These will be designated asbestos structures and will be classified as fibers, bundles, clusters, or matrices. Record as individual fibers any contiguous grouping having 0, 1, or 2 definable intersections. Groupings having more than 2 intersections are to be described as cluster or matrix. See the following Figure 5:

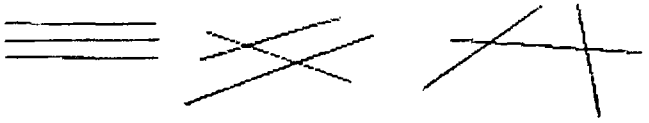
FIGURE 5--COUNTING GUIDELINES USED IN DETERMINING ASBESTOS STRUCTURES

Count as 1 fiber; 1 structure; no intersections.



Count as 2 fibers if space between fibers is greater than width of 1 fiber diameter or number of intersections is equal to or less than 1.

Count as 3 structures if space between fibers is greater than width of 1 fiber diameter or if the number of intersections is equal to or less than 2.



Count bundles as 1 structure; 3 or more parallel fibrils less than 1 fiber diameter separation.

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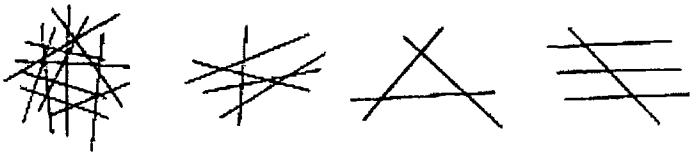
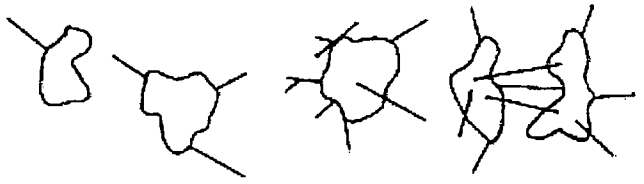
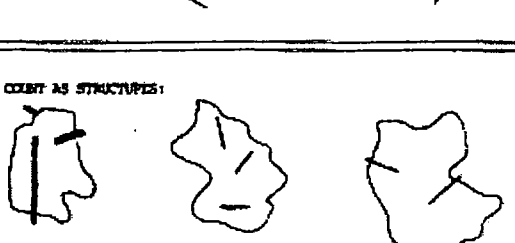
Count clusters as 1 structure; fibers having greater than or equal to 3 intersections.



Count matrix as 1 structure.



DO NOT COUNT AS STRUCTURES:



—— <3.5 micrometer in length
__ <5:1 Aspect Ratio

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An intersection is a non-parallel touching or crossing of fibers, with the projection having an aspect ratio of 5:1 or greater. Combinations such as a matrix and cluster, matrix and bundle, or bundle and cluster are categorized by the dominant fiber quality -- cluster, bundle, and matrix, respectively. Separate categories will be maintained for fibers less than 5 µm and for fibers greater than or equal to 5 µm in length. Not required, but useful, may be to record the fiber length in 1 µm intervals. (Identify each structure morphologically and analyze it as it enters the "window".)

(1) *Fiber.* A structure having a minimum length greater than 0.5 µm and an aspect ratio (length to width) of 5:1 or greater and substantially parallel sides. Note the appearance of the end of the fiber, i.e., whether it is flat, rounded or dovetailed, no intersections.

(2) *Bundle.* A structure composed of 3 or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

(3) *Cluster.* A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group; groupings must have more than 2 intersections.

(4) *Matrix.* Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

(5) *NSD.* Record NSD when no structures are detected in the field.

(6) *Intersection.* Non-parallel touching or crossing of fibers, with the projection having an aspect ratio 5:1 or greater.

ii. Structure Measurement.

(1) Recognize the structure that is to be sized.

(2) Memorize its location in the "window" relative to the sides, inscribed square and to other particulates in the field so this exact location can be found again when scanning is resumed.

(3) Measure the structure using the scale on the screen.

(4) Record the length category and structure type classification on the count sheet after the field number and fiber number.

(5) Return the fiber to its original location in the window and scan the rest of the field for other fibers; if the direction of travel is not remembered, return to the right side of the field and begin the traverse again.

i. Visual identification of Electron Diffraction (ED) patterns is required for each asbestos structure counted which would cause the analysis to exceed the 70 s/mm ^{2} concentration. (Generally this means the first four fibers identified as asbestos must exhibit an identifiable diffraction pattern for chrysotile or amphibole.)

i. Center the structure, focus, and obtain an ED pattern. (See Microscope Instruction Manual for more detailed instructions.)

ii. From a visual examination of the ED pattern, obtained with a short camera length, classify the observed structure as belonging to one of the following classifications: chrysotile, amphibole, or nonasbestos.

(1) Chrysotile: The chrysotile asbestos pattern has characteristic streaks on the layer lines other than the central line and some streaking also on the central line. There will be spots of

normal sharpness on the central layer line and on alternate lines (2nd, 4th, etc.). The repeat distance between layer lines is 0.53 nm and the center doublet is at 0.73 nm. The pattern should display (002), (110), (130) diffraction maxima; distances and geometry should match a chrysotile pattern and be measured semiquantitatively.

(2) Amphibole Group [includes grunerite (amosite), crocidolite, anthophyllite, tremolite, and actinolite]: Amphibole asbestos fiber patterns show layer lines formed by very closely spaced dots, and the repeat distance between layer lines is also about 0.53 nm. Streaking in layer lines is occasionally present due to crystal structure defects.

(3) Nonasbestos: Incomplete or unobtainable ED patterns, a nonasbestos EDXA, or a nonasbestos morphology.

iii. The micrograph number of the recorded diffraction patterns must be reported to the client and maintained in the laboratory's quality assurance records. The records must also demonstrate that the identification of the pattern has been verified by a qualified individual and that the operator who made the identification is maintaining at least an 80 percent correct visual identification based on his measured patterns. In the event that examination of the pattern by the qualified individual indicates that the pattern had been misidentified visually, the client shall be contacted. If the pattern is a suspected chrysotile, take a photograph of the diffraction pattern at 0 degrees tilt. If the structure is suspected to be amphibole, the sample may have to be tilted to obtain a simple geometric array of spots.

j. Energy Dispersive X-Ray Analysis (EDXA).

i. Required of all amphiboles which would cause the analysis results to exceed the 70 s/mm ^{2} concentration. (Generally speaking, the first 4 amphiboles would require EDXA.)

ii. Can be used alone to confirm chrysotile after the 70 s/mm ^{2} concentration has been exceeded.

iii. Can be used alone to confirm all nonasbestos.

iv. Compare spectrum profiles with profiles obtained from asbestos standards. The closest match identifies and categorizes the structure.

v. If the EDXA is used for confirmation, record the properly labeled spectrum on a computer disk, or if a hard copy, file with analysis data.

vi. If the number of fibers in the nonasbestos class would cause the analysis to exceed the 70 s/mm ^{2} concentration, their identities must be confirmed by EDXA or measurement of a zone axis diffraction pattern to establish that the particles are nonasbestos.

k. Stopping Rules.

i. If more than 50 asbestiform structures are counted in a particular grid opening, the analysis may be terminated.

ii. After having counted 50 asbestiform structures in a minimum of 4 grid openings, the analysis may be terminated. The grid opening in which the 50th fiber was counted must be completed.

iii. For blank samples, the analysis is always continued until 10 grid openings have been analyzed.

iv. In all other samples the analysis shall be continued until an analytical sensitivity of 0.005 s/cm ^{3} is reached.

l. Recording Rules. The count sheet should contain the following information:

i. Field (grid opening): List field number.

ii. Record "NSD" if no structures are detected.

iii. Structure information.

(1) If fibers, bundles, clusters, and/or matrices are found, list them in consecutive numerical order, starting over with each field.

(2) Length. Record length category of asbestos fibers examined. Indicate if less than 5 µm or greater than or equal to 5 µm.

(3) Structure Type. Positive identification of asbestos fibers is required by the method. At least one diffraction pattern of each fiber type from every five samples must be recorded and compared with a standard diffraction pattern. For each asbestos fiber reported, both a morphological descriptor and an identification descriptor shall be specified on the count sheet.

(4) Fibers classified as chrysotile must be identified by diffraction and/or X-ray analysis and recorded on the count sheet. X-ray analysis alone can be used as sole identification only after 70s/mm ^{2} have been exceeded for a particular sample.

(5) Fibers classified as amphiboles must be identified by X-ray analysis and electron diffraction and recorded on the count sheet. (X-ray analysis alone can be used as sole identification only after 70s/mm ^{2} have been exceeded for a particular sample.)

(6) If a diffraction pattern was recorded on film, the micrograph number must be indicated on the count sheet.

(7) If an electron diffraction was attempted and an appropriate spectra is not observed, N should be recorded on the count sheet.

(8) If an X-ray analysis is attempted but not observed, N should be recorded on the count sheet.

(9) If an X-ray analysis spectrum is stored, the file and disk number must be recorded on the count sheet.

m. Classification Rules.

i. *Fiber.* A structure having a minimum length greater than or equal to 0.5 µm and an aspect ratio (length to width) of 5:1 or greater and substantially parallel sides. Note the appearance of the end of the fiber, i.e., whether it is flat, rounded or dovetailed.

ii. *Bundle.* A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

iii. *Cluster.* A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

iv. *Matrix.* Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

v. *NSD.* Record NSD when no structures are detected in the field.

n. After all necessary analyses of a particle structure have been completed, return the goniometer stage to 0 degrees, and return the structure to its original location by recall of the original location.

o. Continue scanning until all the structures are identified, classified and sized in the field.

p. Select additional fields (grid openings) at low magnification; scan at a chosen magnification (15,000 to 20,000X screen magnification); and analyze until the stopping rule becomes applicable.

q. Carefully record all data as they are being collected, and check for accuracy.

r. After finishing with a grid, remove it from the microscope, and replace it in the appropriate grid hold. Sample grids must be stored for a minimum of 1 year from the date of the analysis; the sample cassette must be retained for a minimum of 30 days by the laboratory or returned at the client's request.

H. Sample Analytical Sequence

1. Carry out visual inspection of work site prior to air monitoring.

2. Collect a minimum of five air samples inside the work site and five samples outside the work site. The indoor and outdoor samples shall be taken during the same time period.

3. Analyze the abatement area samples according to this protocol. The analysis must meet the 0.005 s/cm ^{3} analytical sensitivity.

4. Remaining steps in the analytical sequence are contained in Unit IV. of this Appendix.

I. Reporting

The following information must be reported to the client. See the following Table II:

TABLE II—EXAMPLE LABORATORY LETTERHEAD

Laboratory I.D.	Client I.D.	FILTER MEDIA DATA				Analyzed Area, mm^2	Sample Volume, cc
		Type	Diameter, mm	Effective Area, mm^2	Pore Size, µm		

INDIVIDUAL ANALYTICAL RESULTS

Laboratory I.D.	Client I.D.	# Asbestos Structures	Analytical Sensitivity, s/cc	CONCENTRATION	
				Structures/cc^1	Structures/cc

The analysis was carried out to the approved TEM method. This laboratory is in compliance with the quality specified by the method.

Authorized Signature

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1. Concentration in structures per square millimeter and structures per cubic centimeter.

2. Analytical sensitivity used for the analysis.

3. Number of asbestos structures.

4. Area analyzed.

5. Volume of air samples (which was initially provided by client).

6. Average grid size opening.

7. Number of grids analyzed.

8. Copy of the count sheet must be included with the report.

9. Signature of laboratory official to indicate that the laboratory met specifications of the AHERA method.

10. Report form must contain official laboratory identification (e.g., letterhead).

11. Type of asbestos.

J. Calibration Methodology

Note: Appropriate implementation of the method requires a person knowledgeable in electron diffraction and mineral identification by ED and EDXA. Those inexperienced laboratories wishing to develop capabilities may acquire necessary knowledge through analysis of appropriate standards and by following detailed methods as described in References 8 and 10 of Unit III.L.

1. *Equipment Calibration.* In this method, calibration is required for the air-sampling equipment and the transmission electron microscope (TEM).

a. *TEM Magnification.* The magnification at the fluorescent screen of the TEM must be calibrated at the grid opening magnification (if used) and also at the magnification used for fiber counting. This is performed with a cross grating replica. A logbook must be maintained, and the dates of calibration depend on the past history of the particular microscope; no frequency is specified. After any maintenance of the microscope that involved adjustment of the power supplied to the lenses or the high-voltage system or the mechanical disassembly of the electron optical column apart from filament exchange, the magnification must be recalibrated. Before the TEM calibration is performed, the analyst must ensure that the cross grating replica is placed at the same distance from the objective lens as the specimens are. For instruments that incorporate an eucentric tilting specimen stage, all speciments and the cross grating replica must be placed at the eucentric position.

b. Determination of the TEM magnification on the fluorescent screen.

i. Define a field of view on the fluorescent screen either by markings or physical boundaries. The field of view must be measurable or previously inscribed with a scale or concentric circles (all scales should be metric).

ii. Insert a diffraction grating replica (for example a grating containing 2,160 lines/mm) into the specimen holder and place into the microscope. Orient the replica so that the grating lines fall perpendicular to the scale on the TEM fluorescent screen. Ensure that the goniometer stage tilt is 0 degrees.

iii. Adjust microscope magnification to 10,000X or 20,000X. Measure the distance (mm) between two widely separated lines on the grating replica. Note the number of spaces between the lines. Take care to measure between the same relative positions on the lines (e.g., between left edges of lines).

Note: The more spaces included in the measurement, the more accurate the final calculation. On most microscopes, however, the magnification is substantially constant only within the central 8-10 cm diameter region of the fluorescent screen.

iv. Calculate the true magnification (M) on the fluorescent screen:

M=XG/Y

where:

X=total distance (mm) between the designated grating lines;

G=calibration constant of the grating replica (lines/mm):

Y=number of grating replica spaces counted along X.

c. Calibration of the EDXA System. Initially, the EDXA system must be calibrated by using two reference elements to calibrate the energy scale of the instrument. When this has been completed in accordance with the manufacturer's instructions, calibration in terms of the different types of asbestos can proceed. The EDXA detectors vary in both solid angle of detection and in window thickness. Therefore, at a particular accelerating voltage in use on the TEM, the count rate obtained from specific dimensions of fiber will vary both in absolute X-ray count rate and in the relative X-ray peak heights for different elements. Only a few minerals are relevant for asbestos abatement work, and in this procedure the calibration is specified in terms of a "fingerprint" technique. The EDXA spectra must be recorded from individual fibers of the relevant minerals, and identifications are made on the basis of semiquantitative comparisons with these reference spectra.

d. Calibration of Grid Openings.

i. Measure 20 grid openings on each of 20 random 200-mesh copper grids by placing a grid on a glass slide and examining it under the PCM. Use a calibrated graticule to measure the average field diameter and use this number to calculate the field area for an average grid opening. Grids are to be randomly selected from batches up to 1,000.

Note: A grid opening is considered as one field.

ii. The mean grid opening area must be measured for the type of specimen grids in use. This can be accomplished on the TEM at a properly calibrated low magnification or on an optical microscope at a magnification of approximately 400X by using an eyepiece fitted with a scale that has been calibrated against a stage micrometer. Optical microscopy utilizing manual or automated procedures may be used providing instrument calibration can be verified.

e. Determination of Camera Constant and ED Pattern Analysis.

i. The camera length of the TEM in ED operating mode must be calibrated before ED patterns on unknown samples are observed. This can be achieved by using a carbon-coated grid on which a thin film of gold has been sputtered or evaporated. A thin film of gold is evaporated on the specimen TEM grid to obtain zone-axis ED patterns superimposed with a ring pattern from the polycrystalline gold film.

ii. In practice, it is desirable to optimize the thickness of the gold film so that only one or two

sharp rings are obtained on the superimposed ED pattern. Thicker gold film would normally give multiple gold rings, but it will tend to mask weaker diffraction spots from the unknown fibrous particulates. Since the unknown d-spacings of most interest in asbestos analysis are those which lie closest to the transmitted beam, multiple gold rings are unnecessary on zone-axis ED patterns. An average camera constant using multiple gold rings can be determined. The camera constant is one-half the diameter, D, of the rings times the interplanar spacing, d, of the ring being measured.

K. Quality Control/Quality Assurance Procedures (Data Quality Indicators)

Monitoring the environment for airborne asbestos requires the use of sensitive sampling and analysis procedures. Because the test is sensitive, it may be influenced by a variety of factors. These include the supplies used in the sampling operation, the performance of the sampling, the preparation of the grid from the filter and the actual examination of this grid in the microscope. Each of these unit operations must produce a product of defined quality if the analytical result is to be a reliable and meaningful test result. Accordingly, a series of control checks and reference standards is performed along with the sample analysis as indicators that the materials used are adequate and the operations are within acceptable limits. In this way, the quality of the data is defined and the results are of known value. These checks and tests also provide timely and specific warning of any problems which might develop within the sampling and analysis operations. A description of these quality control/quality assurance procedures is summarized in the following Table III:

TABLE III--SUMMARY OF LABORATORY DATA QUALITY OBJECTIVES

Unit Operation	QC Check	Frequency	Conformance Expression
Sample receiving	Review of receiving report	Each sample	95% complete
Sample custody	Review of chain-of-custody record	Each sample	95% complete
Sample preparation	Supplies and reagents	On receipt	Meet specs or reject
	Grid opening size	20 openings/20 grids/lot of 3000 or 1 open/sample/lot	100%
	Special clean area monitoring	After cleaning or service	Meet specs or redean
	Laboratory blank	1 per prep area or 10%	Meet specs or reanalyze series
	Plasma etch blank	1 per 20 samples	75%
	Multiple preps (3 per sample)	Each sample	One with count of 25 complete grid sq.
Sample analysis	System check	Each day	Each day
	Alignment check	Each day	Each day
	Magnification calibration with low and high standards	Each month or after service	95%
	ED calibration by gold standard	Weekly	95%
	EDS calibration by copper film	Daily	95%
Performance check	Laboratory blank (measure of cleanliness)	Prep 1 per series or 10% total 1 per 25 samples	Meet specs or reanalyze series
	Replicate counting (measure of precision)	1 per 100 samples	1.5 x Poisson Std. Dev.
	Duplicate analysis (measure of reproducibility)	1 per 100 samples	2 x Poisson Std. Dev.
	Known samples of typical materials (working standards)	Training and for comparison with unknowns	100%
	Analysis of NBS SRM 1876 and/or RM 8410 (measure of accuracy and comparability)	1 per analyst per year	1.5 x Poisson Std. Dev.
	Data entry review (data validation and measure of completeness)	Each sample	99%
	Record and verify ED electron diffraction pattern of structure	1 per 5 samples	80% accuracy
Calculations and data reduction	Hand calculation of automated data reduction procedure or independent recalculation of hand-calculated data	1 per 100 samples	85%

1. When the samples arrive at the laboratory, check the samples and documentation for completeness and requirements before initiating the analysis.

2. Check all laboratory reagents and supplies for acceptable asbestos background levels.

3. Conduct all sample preparation in a clean room environment monitored by laboratory blanks and special testing after cleaning or servicing the room.

4. Prepare multiple grids of each sample.

5. Provide laboratory blanks with each sample batch. Maintain a cumulative average of these results. If this average is greater than 53 f/mm ^{2} per 10 200-mesh grid openings, check the

system for possible sources of contamination.

6. Check for recovery of asbestos from cellulose ester filters submitted to plasma asher.

7. Check for asbestos carryover in the plasma asher by including a blank alongside the positive control sample.

8. Perform a systems check on the transmission electron microscope daily.

9. Make periodic performance checks of magnification, electron diffraction and energy dispersive X-ray systems as set forth in Table III of Unit III.K.

10. Ensure qualified operator performance by evaluation of replicate counting, duplicate analysis, and standard sample comparisons as set forth in Table III of Unit III.K.

11. Validate all data entries.

12. Recalculate a percentage of all computations and automatic data reduction steps as specified in Table III.

13. Record an electron diffraction pattern of one asbestos structure from every five samples that contain asbestos. Verify the identification of the pattern by measurement or comparison of the pattern with patterns collected from standards under the same conditions.

The outline of quality control procedures presented above is viewed as the minimum required to assure that quality data is produced for clearance testing of an asbestos abated area. Additional information may be gained by other control tests. Specifics on those control procedures and options available for environmental testing can be obtained by consulting References 6, 7, and 11 of Unit III.L.

L. References

For additional background information on this method the following references should be consulted.

1. "Guidelines for Controlling Asbestos-Containing Materials in Buildings," EPA 560/5-85-024, June 1985.

2. "Measuring Airborne Asbestos Following an Abatement Action," USEP/Office of Pollution Prevention and Toxics, EPA 600/4-85-049, 1985.

3. Small, John and E. Steel. Asbestos Standards: Materials and Analytical Methods. N.B.S. Special Publication 619, 1982.

4. Campbell, W.J., R.L. Blake, L.L. Brown, E.E. Cather, and J.J. Sjoberg. Selected Silicate Minerals and Their Asbestiform Varieties. Information Circular 8751, U.S. Bureau of Mines, 1977.

5. Quality Assurance Handbook for Air Pollution Measurement System. Ambient Air Methods, EPA 600/4-77-027a, USEPA, Office of Research and Development, 1977.

6. Method 2A: Direct Measurement of Gas Volume Through Pipes and Small Ducts. 40 CFR Part 60 Appendix A.

7. Burdette, G.J. Health & Safety Exec., Research & Lab. Services Div., London, "Proposed Analytical Method for Determination of Asbestos in Air."

8. Chatfield, E.J., Chatfield Tech. Cons., Ltd., Clark, T., PEI Assoc. "Standard Operating Procedure for Determination of Airborne Asbestos Fibers by Transmission Electron Microscopy

Using Polycarbonate Membrane Filters." WERL SOP 87-1, March 5, 1987.

9. NIOSH. Method 7402 for Asbestos Fibers, December 11, 1986 Draft.

10. Yamate, G., S.C. Agarwall, R.D. Gibbons, IIT Research Institute, "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy." Draft report, USEPA Contract 68-02-3266, July 1984.

11. Guidance to the Preparation of Quality Assurance Project Plans. USEPA, Office of Pollution Prevention and Toxics, 1984.

IV. Mandatory Interpretation of Transmission Electron Microscopy Results to Determine Completion of Response Actions

A. Introduction

A response action is determined to be completed by TEM when the abatement area has been cleaned and the airborne asbestos concentration inside the abatement area is no higher than concentrations at locations outside the abatement area. "Outside" means outside the abatement area, but not necessarily outside the building. EPA reasons that an asbestos removal contractor cannot be expected to clean an abatement area to an airborne asbestos concentration that is lower than the concentration of air entering the abatement area from outdoors or from other parts of the building. After the abatement area has passed a thorough visual inspection, and before the outer containment barrier is removed, a minimum of five air samples inside the abatement area and a minimum of five air samples outside the abatement area must be collected. Hence, the response action is determined to be completed when the average airborne asbestos concentration measured inside the abatement area is not statistically different from the average airborne asbestos concentration measured outside the abatement area.

The inside and outside concentrations are compared by the Z-test, a statistical test that takes into account the variability in the measurement process. A minimum of five samples inside the abatement area and five samples outside the abatement area are required to control the false negative error rate, i.e., the probability of declaring the removal complete when, in fact, the air concentration inside the abatement area is significantly higher than outside the abatement area. Additional quality control is provided by requiring three blanks (filters through which no air has been drawn) to be analyzed to check for unusually high filter contamination that would distort the test results.

When volumes greater than or equal to 1,199 L for a 25 mm filter and 2,799 L for a 37 mm filter have been collected and the average number of asbestos structures on samples inside the abatementareaisnogreater than 70 s/mm ^{2} of filter, the response action may be considered complete without comparing the inside samples to the outside samples. EPA is permitting this initial screening test to save analysis costs in situations where the airborne asbestos concentration is sufficiently low so that it cannot be distinguished from the filter contamination/background level (fibers deposited on the filter that are unrelated to the air being sampled). The screening test cannot be used when volumes of less than 1,199 L for 25 mm filter or 2,799 L for a 37 mm filter are collected because the ability to distinguish levels significantly different from filter background is reduced at low volumes.

The initial screening test is expressed in structures per square millimeter of filter because filter background levels come from sources other than the air being sampled and cannot be meaningfully expressed as a concentration per cubic centimeter of air. The value of 70 s/mm ^{2} is based on the experience of the panel of microscopists who consider one structure in 10 grid openings (each grid opening with an area of 0.0057 mm ^{2}) to be comparable with contamination/background levels of blank filters. The decision is based, in part, on Poisson statistics which indicate that four structures must be counted on a filter before the fiber count is statistically distinguishable from the count for one structure. As more information on the performance of the method is collected, this criterion may be modified. Since different

combinations of the number and size of grid openings are permitted under the TEM protocol, the criterion is expressed in structures per square millimeter of filter to be consistent across all combinations. Four structures per 10 grid openings corresponds to approximately 70 s/mm ^{2}.

B. Sample Collection and Analysis

1. A minimum of 13 samples is required: five samples collected inside the abatement area, five samples collected outside the abatement area, two field blanks, and one sealed blank.

2. Sampling and TEM analysis must be done according to either the mandatory or nonmandatory protocols in Appendix A. At least 0.057 mm ^{2} of filter must be examined on blank filters.

C. Interpretation of Results

1. The response action shall be considered complete if either:

a. Each sample collected inside the abatement area consists of at least 1,199 L of air for a 25 mm filter, or 2,799 L of air for a 37 mm filter, and the arithmetic mean of their asbestos structure concentrations per square millimeter of filter is less than or equal to 70 s/mm ^{2}; or

b. The three blank samples have an arithmetic mean of the asbestos structure concentration on the blank filtersthatislessthanor equal to 70 s/mm ^{2} and the average airborne asbestos concentration measured inside the abatement area is not statistically higher than the average airborne asbestos concentration measured outside the abatement area as determined by the Z-test. The Z-test is carried out by calculating

$$Z = \frac{\bar{Y}_I - \bar{Y}_O}{0.8(1/n_I + 1/n_O)^{1/2}}$$

where YI is the average of the natural logarithms of the inside samples and YO is the average of the natural logarithms of the outside samples, nI is the number of inside samples and nO is the number of outside samples. The response action is considered complete if Z is less than or equal to 1.65.

Note: When no fibers are counted, the calculated detection limit for that analysis is inserted for the concentration.

2. If the abatement site does not satisfy either (1) or (2) of this Section C, the site must be recleaned and a new set of samples collected.

D. Sequence for Analyzing Samples

It is possible to determine completion of the response action without analyzing all samples. Also, at any point in the process, a decision may be made to terminate the analysis of existing samples, reclean the abatement site, and collect a new set of samples. The following sequence is outlined to minimize the number of analyses needed to reach a decision.

1. Analyze the inside samples.

2. If at least 1,199 L of air for a 25 mm filter or 2,799 L of air for a 37 mm filter is collected for each inside sample and the arithmetic mean concentration of structures per square millimeter of filter is less than or equal to 70 s/mm ^{2}, the response action is complete and no further analysis is needed.

3. If less than 1,199 L of air for a 25 mm filter or 2,799 L of air for a 37 mm filter is collected for any of the inside samples, or the arithmetic mean concentration of structures per square millimeteroffilterisgreaterthan 70 s/mm ^{2}, analyze the three blanks.

4. If the arithmetic mean concentration of structures per square millimeter on the blank filters is greater than 70 s/mm ^{2}, terminate the analysis, identify and correct the source of blank contamination, and collect a new set of samples.

5. If the arithmetic mean concentration of structures per square millimeter on the blank filters is less than or equal to 70 s/mm ^{2}, analyze the outside samples and perform the Z-test.

6. If the Z-statistic is less than or equal to 1.65, the response action is complete. If the Z-statistic is greater than 1.65, reclean the abatement site and collect a new set of samples.

[52 FR 41857, Oct. 30, 1987]

Appendix B to Subpart E of Part 763 [Reserved]

Regulations (Standards - 29 CFR)

Sampling and Analysis - Non-mandatory - 1926.1101 App B

Regulations (Standards - 29 CFR) - Table of Contents

Part Number:	1926
Part Title:	Safety and Health Regulations for Construction
Subpart:	Z
Subpart Title:	Toxic and Hazardous Substances
Standard Number:	1926.1101 App B
Title:	Sampling and Analysis - Non-mandatory

Matrix

Matrix:
OSHA Permissible Exposure Limits:
Time Weighted Average..... 0.1 fiber/cc
Excursion Level (30 minutes)..... 1.0 fiber/cc
Collection Procedure:
A known volume of air is drawn through a 25-mm diameter cassette containing a mixed-cellulose ester filter. The cassette must be equipped with an electrically conductive 50-mm extension cowl. The sampling time and rate are chosen to give a fiber density of between 100 to 1,300 fibers/mm2 on the filter.

Recommended Sampling Rate..... 0.5 to 5.0 liters/minute (L/min)
Recommended Air Volumes:
Minimum..... 25 L
Maximum..... 2,400 L

Analytical Procedure:

A portion of the sample filter is cleared and prepared for asbestos fiber counting by Phase Contrast Microscopy (PCM) at 400X.

Commercial manufacturers and products mentioned in this method are for descriptive use only and do not constitute endorsements by USDOL-OSHA. Similar products from other sources can be substituted.

1. Introduction

This method describes the collection of airborne asbestos fibers using calibrated sampling pumps with mixed-

cellulose ester (MCE) filters and analysis by phase contrast microscopy (PCM). Some terms used are unique to this method and are defined below: Asbestos: A term for naturally occurring fibrous minerals. Asbestos includes chrysotile, crocidolite, amosite (cummingtonite-grunerite asbestos), tremolite asbestos, actinolite asbestos, anthophyllite asbestos, and any of these minerals that have been chemically treated and/or altered. The precise chemical formulation of each species will vary with the location from which it was mined. Nominal compositions are listed:

Chrysotile.....	Mg(3)Si(2)O(5)(OH)(4)
Crocidolite.....	Na(2)Fe(3)(2)+Fe(2)(3)+Si(8)O(22)(OH)(2)
Amosite.....	(Mg,Fe)(7)Si(8)O(22)(OH)(2)
Tremolite-actinolite.....	Ca(2)(Mg,Fe)(5)Si(8)O(22)(OH)(2)
Anthophyllite.....	(Mg,Fe)(7)Si(8)O(22)(OH)(2)

Asbestos Fiber: A fiber of asbestos which meets the criteria specified below for a fiber.

Aspect Ratio: The ratio of the length of a fiber to it's diameter (e.g. 3:1, 5:1 aspect ratios).

Cleavage Fragments: Mineral particles formed by comminution of minerals, especially those characterized by parallel sides and a moderate aspect ratio (usually less than 20:1).

Detection Limit: The number of fibers necessary to be 95% certain that the result is greater than zero.

Differential Counting: The term applied to the practice of excluding certain kinds of fibers from the fiber count because they do not appear to be asbestos.

Fiber: A particle that is 5 um or longer, with a length-to-width ratio of 3 to 1 or longer.

Field: The area within the graticule circle that is superimposed on the microscope image.

Set: The samples which are taken, submitted to the laboratory, analyzed, and for which, interim or final result reports are generated.

Tremolite, Anthophyllite, and Actinolite: The non-asbestos form of these minerals which meet the definition of a fiber. It includes any of these minerals that have been chemically treated and/or altered.

Walton-Beckett Graticule: An eyepiece graticule specifically designed for asbestos fiber counting. It consists of a circle with a projected diameter of 100 plus or minus 2 um (area of about 0.00785 mm(2)) with a crosshair having tic-marks at 3-um intervals in one direction and 5-um in the orthogonal direction. There are marks around the periphery of the circle to demonstrate the proper sizes and shapes of fibers. This design is reproduced in Figure 1. The disk is placed in one of the microscope eyepieces so that the design is superimposed on the field of view.

1.1. History

Early surveys to determine asbestos exposures were conducted using impinger counts of total dust with the counts expressed as million particles per cubic foot. The British Asbestos Research Council recommended filter membrane counting in 1969. In July 1969, the Bureau of Occupational Safety and Health published a filter membrane method for counting asbestos fibers in the United States. This method was refined by NIOSH and published as P & CAM 239. On May 29, 1971, OSHA specified filter membrane sampling with phase contrast counting for evaluation of asbestos exposures at work sites in the United States. The use of this technique was again required by OSHA in 1986. Phase contrast microscopy has continued to be the method of choice for the measurement of occupational exposure to asbestos.

1.2. Principle

Air is drawn through a MCE filter to capture airborne asbestos fibers. A wedge shaped portion of the filter is removed, placed on a glass microscope slide and made transparent. A measured area (field) is viewed by PCM. All the fibers meeting defined criteria for asbestos are counted and considered a measure of the airborne asbestos concentration.

1.3. Advantages and Disadvantages

There are four main advantages of PCM over other methods:

(1) The technique is specific for fibers. Phase contrast is a fiber counting technique which excludes non-fibrous particles from the analysis.

(2) The technique is inexpensive and does not require specialized knowledge to carry out the analysis for total fiber counts.

(3) The analysis is quick and can be performed on-site for rapid determination of air concentrations of asbestos fibers.

(4) The technique has continuity with historical epidemiological studies so that estimates of expected disease can be inferred from long-term determinations of asbestos exposures.

The main disadvantage of PCM is that it does not positively identify asbestos fibers. Other fibers which are not asbestos may be included in the count unless differential counting is performed. This requires a great deal of experience to adequately differentiate asbestos from non-asbestos fibers. Positive identification of asbestos must be performed by polarized light or electron microscopy techniques. A further disadvantage of PCM is that the smallest visible fibers are about 0.2 um in diameter while the finest asbestos fibers may be as small as 0.02 um in diameter. For some exposures, substantially more fibers may be present than are actually counted.

1.4. Workplace Exposure

Asbestos is used by the construction industry in such products as shingles, floor tiles, asbestos cement, roofing felts, insulation and acoustical products. Non-construction uses include brakes, clutch facings, paper, paints, plastics, and fabrics. One of the most significant exposures in the workplace is the removal and encapsulation of asbestos in schools, public buildings, and homes. Many workers have the potential to be exposed to asbestos during these operations.

About 95% of the asbestos in commercial use in the United States is chrysotile. Crocidolite and amosite make up most of the remainder. Anthophyllite and tremolite or actinolite are likely to be encountered as contaminants in various industrial products.

1.5. Physical Properties

Asbestos fiber possesses a high tensile strength along its axis, is chemically inert, non-combustible, and heat resistant. It has a high electrical resistance and good sound absorbing properties. It can be weaved into cables, fabrics or other textiles, and also matted into asbestos papers, felts, or mats.

2. Range and Detection Limit

2.1. The ideal counting range on the filter is 100 to 1,300 fibers/mm(2). With a Walton-Beckett graticule this range is equivalent to 0.8 to 10 fibers/field. Using NIOSH counting statistics, a count of 0.8 fibers/field would give an approximate coefficient of variation (CV) of 0.13.

2.2. The detection limit for this method is 4.0 fibers per 100 fields or 5.5 fibers/mm(2). This was determined using an equation to estimate the maximum CV possible at a specific concentration (95% confidence) and a Lower Control Limit of zero. The CV value was then used to determine a corresponding concentration from historical CV vs fiber relationships. As an example:

```
Lower Control Limit (95% Confidence) = AC -- 1.645(CV)(AC)

Where:

AC = Estimate of the airborne fiber concentration (fibers/cc) Setting the
     Lower Control Limit = 0 and solving for CV:
0  = AC -- 1.645(CV)(AC)
CV = 0.61
```

This value was compared with CV vs. count curves. The count at which CV = 0.61 for Leidel-Busch counting statistics or for an OSHA Salt Lake Technical Center (OSHA-SLTC) CV curve (see Appendix A for further information) was 4.4 fibers or 3.9 fibers per 100 fields, respectively. Although a lower detection limit of 4 fibers per 100 fields is supported by the OSHA-SLTC data, both data sets support the 4.5 fibers per 100 fields value.

3. Method Performance -- Precision and Accuracy

Precision is dependent upon the total number of fibers counted and the uniformity of the fiber distribution on the filter. A general rule is to count at least 20 and not more than 100 fields. The count is discontinued when 100 fibers are counted, provided that 20 fields have already been counted. Counting more than 100 fibers results in only a small gain in precision. As the total count drops below 10 fibers, an accelerated loss of precision is noted.

At this time, there is no known method to determine the absolute accuracy of the asbestos analysis. Results of samples prepared through the Proficiency Analytical Testing (PAT) Program and analyzed by the OSHA-SLTC showed no significant bias when compared to PAT reference values. The PAT samples were analyzed from 1987 to 1989 (N = 36) and the concentration range was from 120 to 1,300 fibers/mm(2).

4. Interferences

Fibrous substances, if present, may interfere with asbestos analysis.

Some common fibers are:

```
Fiberglass
Anhydrite
Plant Fibers
Perlite Veins
Gypsum
Some Synthetic Fibers
Membrane Structures
Sponge Spicules
Diatoms
Microorganisms
Wollastonite
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The use of electron microscopy or optical tests such as polarized light, and dispersion staining may be used to differentiate these materials from asbestos when necessary.

5. Sampling

5.1. Equipment

5.1.1. Sample assembly (The assembly is shown in Figure 3). Conductive filter holder consisting of a 25-mm diameter, 3-piece cassette having a 50-mm long electrically conductive extension cowl. Backup pad, 25-mm, cellulose. Membrane filter, mixed-cellulose ester (MCE), 25-mm, plain, white, 0.4 to 1.2-um pore size.

Notes:

(a) DO NOT RE-USE CASSETTES.

(b) Fully conductive cassettes are required to reduce fiber loss to the sides of the cassette due to electrostatic attraction.

(c) Purchase filters which have been selected by the manufacturer for asbestos counting or analyze representative filters for fiber background before use. Discard the filter lot if more than 4 fibers/ 100 fields are found.

(d) To decrease the possibility of contamination, the sampling system (filter-backup pad-cassette) for asbestos is usually preassembled by the manufacturer.

(e) Other cassettes, such as the Bell-mouth, may be used within the limits of their validation.

5.1.2. Gel bands for sealing cassettes.

5.1.3. Sampling pump.

Each pump must be a battery operated, self-contained unit small enough to be placed on the monitored employee and not interfere with the work being performed. The pump must be capable of sampling at the collection rate for the required sampling time.

5.1.4. Flexible tubing, 6-mm bore.

5.1.5. Pump calibration.

Stopwatch and bubble tube/burette or electronic meter.

5.2. Sampling Procedure

5.2.1. Seal the point where the base and cowl of each cassette meet with a gel band or tape.

5.2.2. Charge the pumps completely before beginning.

5.2.3. Connect each pump to a calibration cassette with an appropriate length of 6-mm bore plastic tubing. Do not use luer connectors -- the type of cassette specified above has built-in adapters.

5.2.4. Select an appropriate flow rate for the situation being monitored. The sampling flow rate must be between 0.5 and 5.0 L/min for personal sampling and is commonly set between 1 and 2 L/min. Always choose a flow rate that will not produce overloaded filters.

5.2.5. Calibrate each sampling pump before and after sampling with a calibration cassette in-line (Note: This calibration cassette should be from the same lot of cassettes used for sampling). Use a primary standard (e.g.

bubble burette) to calibrate each pump. If possible, calibrate at the sampling site.

Note: If sampling site calibration is not possible, environmental influences may affect the flow rate. The extent is dependent on the type of pump used. Consult with the pump manufacturer to determine dependence on environmental influences. If the pump is affected by temperature and pressure changes, correct the flow rate using the formula shown in the section "Sampling Pump Flow Rate Corrections" at the end of this appendix.

5.2.6. Connect each pump to the base of each sampling cassette with flexible tubing. Remove the end cap of each cassette and take each air sample open face. Assure that each sample cassette is held open side down in the employee's breathing zone during sampling. The distance from the nose/mouth of the employee to the cassette should be about 10 cm. Secure the cassette on the collar or lapel of the employee using spring clips or other similar devices.

5.2.7. A suggested minimum air volume when sampling to determine TWA compliance is 25 L. For Excursion Limit (30 min sampling time) evaluations, a minimum air volume of 48 L is recommended.

5.2.8. The most significant problem when sampling for asbestos is overloading the filter with non-asbestos dust. Suggested maximum air sample volumes for specific environments are:

Environment	Air Vol. (L)
Asbestos removal operations (visible dust)	100.
Asbestos removal operations (little dust)	240.
Office environments	400 to 2,400.

CAUTION: Do not overload the filter with dust. High levels of non-fibrous dust particles may obscure fibers on the filter and lower the count or make counting impossible. If more than about 25 to 30% of the field area is obscured with dust, the result may be biased low. Smaller air volumes may be necessary when there is excessive non-asbestos dust in the air.

While sampling, observe the filter with a small flashlight. If there is a visible layer of dust on the filter, stop sampling, remove and seal the cassette, and replace with a new sampling assembly. The total dust loading should not exceed 1 mg.

5.2.9. Blank samples are used to determine if any contamination has occurred during sample handling. Prepare two blanks for the first 1 to 20 samples. For sets containing greater than 20 samples, prepare blanks as 10% of the samples. Handle blank samples in the same manner as air samples with one exception: Do not draw any air through the blank samples. Open the blank cassette in the place where the sample cassettes are mounted on the employee. Hold it open for about 30 seconds. Close and seal the cassette appropriately. Store blanks for shipment with the sample cassettes.

5.2.10. Immediately after sampling, close and seal each cassette with the base and plastic plugs. Do not touch or puncture the filter membrane as this will invalidate the analysis.

5.2.11. Attach and secure a sample seal around each sample cassette in such a way as to assure that the end cap and base plugs cannot be removed without destroying the seal. Tape the ends of the seal together since the seal is not long enough to be wrapped end-to-end. Also wrap tape around the cassette at each joint to keep the seal secure.

5.3. Sample Shipment

5.3.1. Send the samples to the laboratory with paperwork requesting asbestos analysis. List any known fibrous interferences present during sampling on the paperwork. Also, note the workplace operation(s) sampled.

5.3.2. Secure and handle the samples in such that they will not rattle during shipment nor be exposed to static electricity. Do not ship samples in expanded polystyrene peanuts, vermiculite, paper shreds, or excelsior. Tape sample cassettes to sheet bubbles and place in a container that will cushion the samples in such a manner that they will not rattle.

5.3.3. To avoid the possibility of sample contamination, always ship bulk samples in separate mailing containers.

6. Analysis

6.1. Safety Precautions

6.1.1. Acetone is extremely flammable and precautions must be taken not to ignite it. Avoid using large containers or quantities of acetone. Transfer the solvent in a ventilated laboratory hood. Do not use acetone near any open flame. For generation of acetone vapor, use a spark free heat source.

6.1.2. Any asbestos spills should be cleaned up immediately to prevent dispersal of fibers. Prudence should be exercised to avoid contamination of laboratory facilities or exposure of personnel to asbestos. Asbestos spills should be cleaned up with wet methods and/ or a High Efficiency Particulate-Air (HEPA) filtered vacuum.

CAUTION: Do not use a vacuum without a HEPA filter -- It will disperse fine asbestos fibers in the air.

6.2. Equipment

6.2.1. Phase contrast microscope with binocular or trinocular head.

6.2.2. Widefield or Huygenian 10X eyepieces (NOTE: The eyepiece containing the graticule must be a focusing eyepiece. Use a 40X phase objective with a numerical aperture of 0.65 to 0.75).

6.2.3. Kohler illumination (if possible) with green or blue filter.

6.2.4. Walton-Beckett Graticule, type G-22 with 100 plus or minus 2 um projected diameter.

6.2.5. Mechanical stage. A rotating mechanical stage is convenient for use with polarized light.

6.2.6. Phase telescope.

6.2.7. Stage micrometer with 0.01-mm subdivisions.

6.2.8. Phase-shift test slide, mark II (Available from PTR optics Ltd., and also McCrone).

6.2.9. Precleaned glass slides, 25 mm X 75 mm. One end can be frosted for convenience in writing sample numbers, etc., or paste-on labels can be used.

6.2.10. Cover glass #1 1/2.

6.2.11. Scalpel (#10, curved blade).

6.2.12. Fine tipped forceps.

6.2.13. Aluminum block for clearing filter (see Appendix D and Figure 4).

6.2.14. Automatic adjustable pipette, 100- to 500-uL.

6.2.15. Micropipette, 5 uL.

6.3. Reagents

6.3.1. Acetone (HPLC grade).

6.3.2. Triacetin (glycerol triacetate).

6.3.3. Lacquer or nail polish.

6.4. Standard Preparation

A way to prepare standard asbestos samples of known concentration has not been developed. It is possible to prepare replicate samples of nearly equal concentration. This has been performed through the PAT program. These asbestos samples are distributed by the AIHA to participating laboratories.

Since only about one-fourth of a 25-mm sample membrane is required for an asbestos count, any PAT sample can serve as a "standard" for replicate counting.

6.5. Sample Mounting

Note: See Safety Precautions in Section 6.1. before proceeding. The objective is to produce samples with a smooth (non-grainy) background in a medium with a refractive index of approximately 1.46. The technique below collapses the filter for easier focusing and produces permanent mounts which are useful for quality control and interlaboratory comparison.

An aluminum block or similar device is required for sample preparation.

6.5.1. Heat the aluminum block to about 70 deg.C. The hot block should not be used on any surface that can be damaged by either the heat or from exposure to acetone.

6.5.2. Ensure that the glass slides and cover glasses are free of dust and fibers.

6.5.3. Remove the top plug to prevent a vacuum when the cassette is opened. Clean the outside of the cassette if necessary. Cut the seal and/or tape on the cassette with a razor blade. Very carefully separate the base from the extension cowl, leaving the filter and backup pad in the base.

6.5.4. With a rocking motion cut a triangular wedge from the filter using the scalpel. This wedge should be one-sixth to one-fourth of the filter. Grasp the filter wedge with the forceps on the perimeter of the filter which was clamped between the cassette pieces. DO NOT TOUCH the filter with your finger. Place the filter on the glass slide sample side up. Static electricity will usually keep the filter on the slide until it is cleared.

6.5.5. Place the tip of the micropipette containing about 200 uL acetone into the aluminum block. Insert the glass slide into the receiving slot in the aluminum block. Inject the acetone into the block with slow, steady pressure on the plunger while holding the pipette firmly in place. Wait 3 to 5 seconds for the filter to clear, then remove the pipette and slide from the aluminum block.

6.5.6. Immediately (less than 30 seconds) place 2.5 to 3.5 uL of triacetin on the filter (NOTE: Waiting longer

than 30 seconds will result in increased index of refraction and decreased contrast between the fibers and the preparation. This may also lead to separation of the cover slip from the slide).

6.5.7. Lower a cover slip gently onto the filter at a slight angle to reduce the possibility of forming air bubbles. If more than 30 seconds have elapsed between acetone exposure and triacetin application, glue the edges of the cover slip to the slide with lacquer or nail polish.

6.5.8. If clearing is slow, warm the slide for 15 min on a hot plate having a surface temperature of about 50 deg.C to hasten clearing. The top of the hot block can be used if the slide is not heated too long.

6.5.9. Counting may proceed immediately after clearing and mounting are completed.

6.6. Sample Analysis

Completely align the microscope according to the manufacturer's instructions. Then, align the microscope using the following general alignment routine at the beginning of every counting session and more often if necessary.

6.6.1. Alignment

(1) Clean all optical surfaces. Even a small amount of dirt can significantly degrade the image.

(2) Rough focus the objective on a sample.

(3) Close down the field iris so that it is visible in the field of view. Focus the image of the iris with the condenser focus. Center the image of the iris in the field of view.

(4) Install the phase telescope and focus on the phase rings. Critically center the rings. Misalignment of the rings results in astigmatism which will degrade the image.

(5) Place the phase-shift test slide on the microscope stage and focus on the lines. The analyst must see line set 3 and should see at least parts of 4 and 5 but, not see line set 6 or 6. A microscope/microscopist combination which does not pass this test may not be used.

6.6.2. Counting Fibers

(1) Place the prepared sample slide on the mechanical stage of the microscope. Position the center of the wedge under the objective lens and focus upon the sample.

(2) Start counting from one end of the wedge and progress along a radial line to the other end (count in either direction from perimeter to wedge tip). Select fields randomly, without looking into the eyepieces, by slightly advancing the slide in one direction with the mechanical stage control.

(3) Continually scan over a range of focal planes (generally the upper 10 to 15 um of the filter surface) with the fine focus control during each field count. Spend at least 5 to 15 seconds per field.

(4) Most samples will contain asbestos fibers with fiber diameters less than 1 um. Look carefully for faint fiber images. The small diameter fibers will be very hard to see. However, they are an important contribution to the total count.

(5) Count only fibers equal to or longer than 5 um. Measure the length of curved fibers along the curve.

(6) Count fibers which have a length to width ratio of 3:1 or greater.

(7) Count all the fibers in at least 20 fields. Continue counting until either 100 fibers are counted or 100 fields have been viewed; whichever occurs first. Count all the fibers in the final field.

(8) Fibers lying entirely within the boundary of the Walton-Beckett graticule field shall receive a count of 1. Fibers crossing the boundary once, having one end within the circle shall receive a count of 1/2. Do not count any fiber that crosses the graticule boundary more than once. Reject and do not count any other fibers even though they may be visible outside the graticule area. If a fiber touches the circle, it is considered to cross the line.

(9) Count bundles of fibers as one fiber unless individual fibers can be clearly identified and each individual fiber is clearly not connected to another counted fiber. See Figure 1 for counting conventions.

(10) Record the number of fibers in each field in a consistent way such that filter non-uniformity can be assessed.

(11) Regularly check phase ring alignment.

(12) When an agglomerate (mass of material) covers more than 25% of the field of view, reject the field and select another. Do not include it in the number of fields counted.

(13) Perform a "blind recount" of 1 in every 10 filter wedges (slides). Re-label the slides using a person other than the original counter.

6.7. Fiber Identification

As previously mentioned in Section 1.3., PCM does not provide positive confirmation of asbestos fibers. Alternate differential counting techniques should be used if discrimination is desirable. Differential counting may include primary discrimination based on morphology, polarized light analysis of fibers, or modification of PCM data by Scanning Electron or Transmission Electron Microscopy.

A great deal of experience is required to routinely and correctly perform differential counting. It is discouraged unless it is legally necessary. Then, only if a fiber is obviously not asbestos should it be excluded from the count. Further discussion of this technique can be found in reference 8.10.

If there is a question whether a fiber is asbestos or not, follow the rule:

"WHEN IN DOUBT, COUNT."

6.8. Analytical Recommendations -- Quality Control System

6.8.1. All individuals performing asbestos analysis must have taken the NIOSH course for sampling and evaluating airborne asbestos or an equivalent course.

6.8.2. Each laboratory engaged in asbestos counting shall set up a slide trading arrangement with at least two other laboratories in order to compare performance and eliminate inbreeding of error. The slide exchange occurs at least semiannually. The round robin results shall be posted where all analysts can view individual analyst's results.

6.8.3. Each laboratory engaged in asbestos counting shall participate in the Proficiency Analytical Testing Program, the Asbestos Analyst Registry or equivalent.

6.8.4. Each analyst shall select and count prepared slides from a "slide bank". These are quality assurance counts. The slide bank shall be prepared using uniformly distributed samples taken from the workload. Fiber densities should cover the entire range routinely analyzed by the laboratory. These slides are counted blind by

all counters to establish an original standard deviation. This historical distribution is compared with the quality assurance counts. A counter must have 95% of all quality control samples counted within three standard deviations of the historical mean. This count is then integrated into a new historical mean and standard deviation for the slide.

The analyses done by the counters to establish the slide bank may be used for an interim quality control program if the data are treated in a proper statistical fashion.

7. Calculations

7.1. Calculate the estimated airborne asbestos fiber concentration on the filter sample using the following formula:

(For Equation A, Click Here)

where:

AC = Airborne fiber concentration
FB = Total number of fibers greater than 5 um counted
FL = Total number of fields counted on the filter
BFB = Total number of fibers greater than 5 um counted in the blank
BFL = Total number of fields counted on the blank
ECA = Effective collecting area of filter (385 mm(2) nominal for a 25-mm filter.)
FR = Pump flow rate (L/min)
MFA = Microscope count field area (mm(2)). This is 0.00785 mm(2) for a Walton-Beckett Graticule.
T = Sample collection time (min)
1,000 = Conversion of L to cc

Note: The collection area of a filter is seldom equal to 385 mm(2). It is appropriate for laboratories to routinely monitor the exact diameter using an inside micrometer. The collection area is calculated according to the formula:

Area = pi(d/2)(2)

7.2. Short-Cut Calculation

Since a given analyst always has the same interpupillary distance, the number of fields per filter for a particular analyst will remain constant for a given size filter. The field size for that analyst is constant (i.e. the analyst is using an assigned microscope and is not changing the reticle).

For example, if the exposed area of the filter is always 385 mm(2) and the size of the field is always 0.00785 mm(2) the number of fields per filter will always be 49,000. In addition it is necessary to convert liters of air to cc. These three constants can then be combined such that ECA/(1,000 x MFA) = 49. The previous equation simplifies to:

(For Equation B, Click Here)

7.3. Recount Calculations

As mentioned in step 13 of Section 6.6.2., a "blind recount" of 10% of the slides is performed. In all cases,

differences will be observed between the first and second counts of the same filter wedge. Most of these differences will be due to chance alone, that is, due to the random variability (precision) of the count method. Statistical recount criteria enables one to decide whether observed differences can be explained due to chance alone or are probably due to systematic differences between analysts, microscopes, or other biasing factors.

The following recount criterion is for a pair of counts that estimate AC in fibers/cc. The criterion is given at the type-I error level. That is, there is 5% maximum risk that we will reject a pair of counts for the reason that one might be biased, when the large observed difference is really due to chance.

Reject a pair of counts if:

(For Equation C, Click Here)

Where:

AC(1) = lower estimated airborne fiber concentration
AC(2) = higher estimated airborne fiber concentration
AC(avg) = average of the two concentration estimates
CV(FB) = CV for the average of the two concentration estimates

If a pair of counts are rejected by this criterion then, recount the rest of the filters in the submitted set. Apply the test and reject any other pairs failing the test. Rejection shall include a memo to the industrial hygienist stating that the sample failed a statistical test for homogeneity and the true air concentration may be significantly different than the reported value.

7.4. Reporting Results

Report results to the industrial hygienist as fibers/cc. Use two significant figures. If multiple analyses are performed on a sample, an average of the results is to be reported unless any of the results can be rejected for cause.

8. References

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8.8. Criteria for a Recommended Standard -- Occupational Exposure to Asbestos (DHEW/NIOSH Pub. No. HSM 72-10267), National Institute for Occupational Safety and Health, NIOSH, Cincinnati, OH, 1972. pp. III-1 -- III-24.

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Quality Control

The OSHA asbestos regulations require each laboratory to establish a quality control program. The following is presented as an example of how the OSHA-SLTC constructed its internal CV curve as part of meeting this requirement. Data is from 395 samples collected during OSHA compliance inspections and analyzed from October 1980 through April 1986.

Each sample was counted by 2 to 5 different counters independently of one another. The standard deviation and the CV statistic was calculated for each sample. This data was then plotted on a graph of CV vs. fibers/mm(2). A least squares regression was performed using the following equation:

CV = antilog(10)[A(log(10)(x))(2)+B(log(10)(x))+C]

where:

x = the number of fibers/mm(2)

Application of least squares gave:

A = 0.182205
B = 0.973343
C = 0.327499

Using these values, the equation becomes:

CV = antilog(10)[0.182205(log(10)(x))(2)-0.973343(log (10)(x))+0.327499]

Sampling Pump Flow Rate Corrections

This correction is used if a difference greater than 5% in ambient temperature and/or pressure is noted between calibration and sampling sites and the pump does not compensate for the differences.

(For Equation D, Click Here)

Where:

Q(act) = actual flow rate
Q(cal) = calibrated flow rate (if a rotameter was used, the rotameter value)
P(cal) = uncorrected air pressure at calibration
P(act) = uncorrected air pressure at sampling site
T(act) = temperature at sampling site (K)

T(cal) = temperature at calibration (K)

Walton-Beckett Graticule

When ordering the Graticule for asbestos counting, specify the exact disc diameter needed to fit the ocular of the microscope and the diameter (mm) of the circular counting area. Instructions for measuring the dimensions necessary are listed:

(1) Insert any available graticule into the focusing eyepiece and focus so that the graticule lines are sharp and clear.

(2) Align the microscope.

(3) Place a stage micrometer on the microscope object stage and focus the microscope on the graduated lines.

(4) Measure the magnified grid length, PL (um), using the stage micrometer.

(5) Remove the graticule from the microscope and measure its actual grid length, AL (mm). This can be accomplished by using a mechanical stage fitted with verniers, or a jeweler's loupe with a direct reading scale.

(6) Let D = 100 um. Calculate the circle diameter, d(c)(mm), for the Walton-Beckett graticule and specify the diameter when making a purchase:

$$d(c) = \frac{AL \times D}{PL}$$

Example:

If PL = 108 um, AL = 2.93 mm and D = 100 um,

then,

$$d(c) = \frac{2.93 \times 100}{108} = 2.71\text{mm}$$

(7) Each eyepiece-objective-reticle combination on the microscope must be calibrated. Should any of the three be changed (by zoom adjustment, disassembly, replacement, etc.), the combination must be recalibrated. Calibration may change if interpupillary distance is changed.

Measure the field diameter, D (acceptable range: 100 plus or minus 2 um) with a stage micrometer upon receipt of the graticule from the manufacturer. Determine the field area (mm(2)).

Field Area = pi(D/2)(2)
If D = 100 um = 0.1 mm, then
Field Area = pi(0.1 mm/2)(2) = 0.00785 mm(2)

The Graticule is available from: Graticules Ltd., Morley Road, Tonbridge TN9 IRN, Kent, England (Telephone 011-44-732-359061). Also available from PTR Optics Ltd., 145 Newton Street, Waltham, MA 02154 [telephone (617) 891-6000] or McCrone Accessories and Components, 2506 S. Michigan Ave.,

Chicago, IL 60616 [phone (312)-842-7100]. The graticule is custom made for each microscope.

(For Figure 1 of Walton-Beckett Graticule, Click Here)

Counts for the Fibers in the Figure

Structure No.	Count	Explanation
1 to 6.....	1	Single fibers all contained within the Circle.
7.....	1/2	Fiber crosses circle once.
8.....	0	Fiber too short.
9.....	2	Two crossing fibers.
10.....	0	Fiber outside graticule.
11.....	0	Fiber crosses graticule twice.
12.....	1/2	Although split, fiber only crosses once.

[60 FR 33972, June 29, 1995]

Next Standard (1926.1101 App C)

Regulations (Standards - 29 CFR) - Table of Contents

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Occupational Safety & Health Administration
200 Constitution Avenue, NW
Washington, DC 20210

Sample Custody

SOP 1-2
Revision: 5
Date: March 2007

Prepared: David O. Johnson

Technical Review: S. Budney

E-Signed by Michael C. Malloy
VERIFY authenticity with ApproveIt

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VERIFY authenticity with ApproveIt

Approved: *Signature/Date*

Issued: *Signature/Date*

1.0 Objective

Because of the evidentiary nature of samples collected during environmental investigations, possession must be traceable from the time the samples are collected until their derived data are introduced as evidence in legal proceedings. To maintain and document sample possession, sample custody procedures are followed. All paperwork associated with the sample custody procedures will be retained in CDM Federal Programs Corporation (CDM) files unless the client requests that it be transferred to them for use in legal proceedings or at the completion of the contract.

Note: Sample custody documentation requirements vary with the specific EPA region or client. This SOP is intended to present basic sample custody requirements, along with common options. Specific sample custody requirements shall be presented in the project-specific quality assurance (QA) project plan or project-specific modification or clarification form (see Section U-1).

2.0 Background

2.1 Definitions

Sample - A sample is material to be analyzed that is contained in single or multiple containers representing a unique sample identification number.

Sample Custody - A sample is under custody if:

1. It is in your possession
2. It is in your view, after being in your possession
3. It was in your possession and you locked it up
4. It is in a designated secure area

Chain-of-Custody Record - A chain-of-custody record is a form used to document the transfer of custody of samples from one individual to another.

Custody Seal - A custody seal is a tape-like seal that is part of the chain-of-custody process and is used to detect tampering with samples after they have been packed for shipping.

Sample Label - A sample label is an adhesive label placed on sample containers to designate a sample identification number and other sampling information.

Sample Tag - A sample tag is attached with string to a sample container to designate a sample identification number and other sampling information. Tags may be used when it is difficult to physically place adhesive labels on the container (e.g., in the case of small air sampling tubes).

3.0 General Responsibilities

Sampler - The sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

Field Team Leader - The field team leader (FTL) is responsible for ensuring that strict chain-of-custody procedures are maintained during all sampling events. The FTL is also responsible for coordinating with the subcontractor laboratory to

ensure that adequate information is recorded on custody records. The FTL determines whether proper custody procedures were followed during the fieldwork.

Field Sample Custodian - The field sample custodian, when designated by the FTL, is responsible for accepting custody of samples from the sampler(s) and properly packing and shipping the samples to the laboratory assigned to do the analyses. A field sample custodian is typically designated only for large and complex field efforts.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Supplies

- Chain-of-custody records (applicable client or CDM forms)
- Sample labels and/or tags
- EPA Field Operations Records Management System II Lite™ (FORMS II Lite™) software (if required)
- Printer paper
- Custody seals
- Clear tape
- Computer
- Printer

5.0 Procedures

5.1 Chain-of-Custody Record

This procedure establishes a method for maintaining custody of samples through use of a chain-of-custody record. This procedure will be followed for all samples collected or split samples accepted.

Field Custody

1. Collect only the number of samples needed to represent the media being sampled. To the extent possible, determine the quantity and types of samples and sample locations before the actual fieldwork. As few people as possible shall handle samples.

2. Complete sample labels or tags for each sample using waterproof ink.

3. Maintain personal custody of the samples (in your possession) at all times until custody is transferred for sample shipment or directly to the analytical laboratory.

Transfer of Custody and Shipment

1. Complete a chain-of-custody record for all samples (see Figure 1 for an example of a chain-of-custody record. Similar forms may be used when requested by the client). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the sample custodian in the appropriate laboratory.

    - The date/time will be the same for both signatures when custody is transferred directly to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures. Common carriers are not required to sign the chain-of-custody record.

    - In all cases, it must be readily apparent that the person who received custody is the same person who relinquished custody to the next custodian.

    - If samples are left unattended or a person refuses to sign, this must be documented and explained on the chain-of-custody record.

Note: If a field sample custodian has been designated, he/she may initiate the chain-of-custody record, sign, and date as the relinquisher. The individual sampler(s) must sign in the appropriate block, but does (do) not need to sign and date as a relinquisher (refer to Figure 1).

2. Package samples properly for shipment and dispatch to the appropriate laboratory for analysis. Each shipment must be accompanied by a separate chain-of-custody record. If a shipment consists of multiple coolers, a chain-of-custody record shall be filled out for each cooler documenting only samples contained in that particular cooler.

3. The original record will accompany the shipment, and the copies will be retained by the FTL and, if applicable, distributed to the appropriate sample coordinators. Freight bills will also be retained by the FTL as part of the permanent documentation. The shipping number from the freight bill shall be recorded on the applicable chain-of-custody record and field logbook in accordance with TSOP 4-1, *Field Logbook Content and Control.*

Procedure for Completing CDM Example Chain-of-Custody Record
The following procedure is to be used to fill out the CDM chain-of-custody record. The record provided herein (Figure 1) is an example chain-of-custody record. If another type of custody record (i.e., provided by the EPA Contract Laboratory Program (CLP) or a subcontract laboratory or generated by FORMS II Lite™) is used to track the custody of samples, the custody record shall be filled out in its entirety.

1. Record project number.
2. Record FTL for the project (if a field sample custodian has been designated, also record this name in the "Remarks" box).
3. Record the name and address of the laboratory to which samples are being shipped.
4. Enter the project name/location or code number.
5. Record overnight courier's airbill number.
6. Record sample location number.
7. Record sample number.
8. Note preservatives added to the sample.
9. Note media type (matrix) of the sample.
10. Note sample type (grab or composite).
11. Enter date of sample collection.
12. Enter time of sample collection in military time.
13. When required by the client, enter the names or initials of the samplers next to the sample location number of the sample they collected.
14. List parameters for analysis and the number of containers submitted for each analysis.
15. Enter appropriate designation for laboratory quality control (e.g., matrix spike/matrix spike duplicate [MS/MSD], matrix spike/duplicate [MS/D]), or other remarks (e.g., sample depth).
16. Sign the chain-of-custody record(s) in the space provided. All samplers must sign each record.
17. If sample tags are used, record the sample tag number in the "Remarks" column.
18. The originator checks information entered in Items 1 through 16 and then signs the top left "Relinquished by" box, prints his/her name, and enters the current date and time (military).
19. Send the top two copies (usually white and yellow) with the samples to the laboratory; retain the third copy (usually pink) for the project files. Retain additional copies for the project file or distribute as required to the appropriate sample coordinators.
20. The laboratory sample custodian receiving the sample shipment checks the sample label information against the chain-of-custody record. Sample condition is checked and anything unusual is noted under "Remarks" on the chain-of-custody record. The laboratory custodian receiving custody signs in the adjacent "Received by" box and keeps the copy. The white copy is returned to CDM.

5.2 Sample Labels and Tags

Unless the client directs otherwise, sample labels or tags will be used for all samples collected or accepted for CDM projects.

1. Complete one label or tag with the information required by the client for each sample container collected. A typical label or tag would be completed as follows (see Figure 2 for example of sample tag; labels are completed with the equivalent information):

   - Record the project code (i.e., project or task number).
   - Enter the station number (sample number or EPA CLP identification number) if applicable.
   - Record the date to indicate the month, day, and year of sample collection.
   - Enter the time (military) of sample collection.

- Place a check to indicate composite or grab sample.
- Record the station (sample) location.
- Sign in the space provided.
- Place a check next to "yes" or "no" to indicate if a preservative was added.
- Place a check under "Analyses" next to the parameters for which the sample is to be analyzed. If the desired analysis is not listed, write it in the empty slot. Note: Do not write in the box for "laboratory sample number."
- Place or write additional relevant information under "Remarks."

2. Place adhesive labels directly on the sample containers. Place clear tape over the label to protect from moisture.

3. Securely attach sample tags to the sample bottle. On 2.27 liter (80 oz.) amber bottles, the tag string may be looped through the ring-style handle and tied. On all other containers, it is recommended that the string be looped around the neck of the bottle, then twisted, and relooped around the neck until the slack in the string is removed.

4. Double-check that the information recorded on the sample tag is consistent with the information recorded on the chain-of-custody record.

5.3 Custody Seals

Two custody seals must be placed on opposite corners of all shipping containers (e.g., cooler) before shipment. The seals shall be signed and dated by the shipper.

Custody seals may also be required to be placed on individual sample bottles. Check with the client or refer to EPA regional guidelines for direction.

5.4 Sample Shipping

CDM Federal SOP 2-1, *Packaging and Shipping Environmental Samples* defines the requirements for packaging and shipping environmental samples.

6.0 Restrictions/Limitations

Check with the EPA region or client for specific guidelines. If no specific guidelines are identified, this procedure shall be followed.

For EPA CLP sampling events, combined chain-of-custody/traffic report forms generated with EPA FORMS II Lite™ or other EPA-specific records may be used. Refer to regional guidelines for completing these forms.

The EPA FORMS II Lite™ software may be used to customize sample labels and custody records when directed by the client or the CDM project manager.

7.0 References

U. S. Army Corps of Engineers. 2001. *Requirements for the Preparation of Sampling and Analysis Plan*, EM 200-1-3. Appendix F. February.

U. S. Environmental Protection Agency. Revised March 1992. *National Enforcement Investigations Center, Multi-Media Investigation Manual*, EPA-330/9-89-003-R. p.85.

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_____. 2004. *Contract Laboratory Program (CLP), Guidance for Field Samplers*, EPA-540-R-00-003. Final. Section 3.2. August.

Figure 1
Example CDM Chain-of-Custody Record

CDM

125 Maiden Lane, 5th Floor
New York, NY 10038
(212) 785-0123
Fax: (212) 785-6114

CHAIN OF CUSTODY RECORD

PROJECT ID.	FIELD TEAM LEADER	LABORATORY AND ADDRESS	DATE SHIPPED
PROJECT NAME/LOCATION		LAB CONTRACT:	AIRBILL NO.

MEDIA TYPE
1. Surface Water
2. Groundwater
3. Leachate
4. Field QC
5. Soil/Sediment
6. Oil
7. Waste
8. Other _____

PRESERVATIVES
1. HCl, pH <2
2. HNO3, pH <2
3. NaOH, pH >12
4. H2SO4, pH <2
5. Zinc Acetate, pH >9
6. Ice Only
7. Not Preserved
8. Other _____

SAMPLE TYPE
G = Grab
C = Composite

SAMPLE LOCATION NO.	LABORATORY SAMPLE NUMBER	PRESERVATIVES ADDED	MEDIA TYPE	SAMPLE TYPE	20__ DATE	TIME SAMPLED	ANALYSES (List no. of containers submitted)								REMARKS (Note if MS/MSD)
1.															
2.															
3.															
4.															
5.															
6.															
7.															
8.															
9.															
10.															

SAMPLER SIGNATURES:

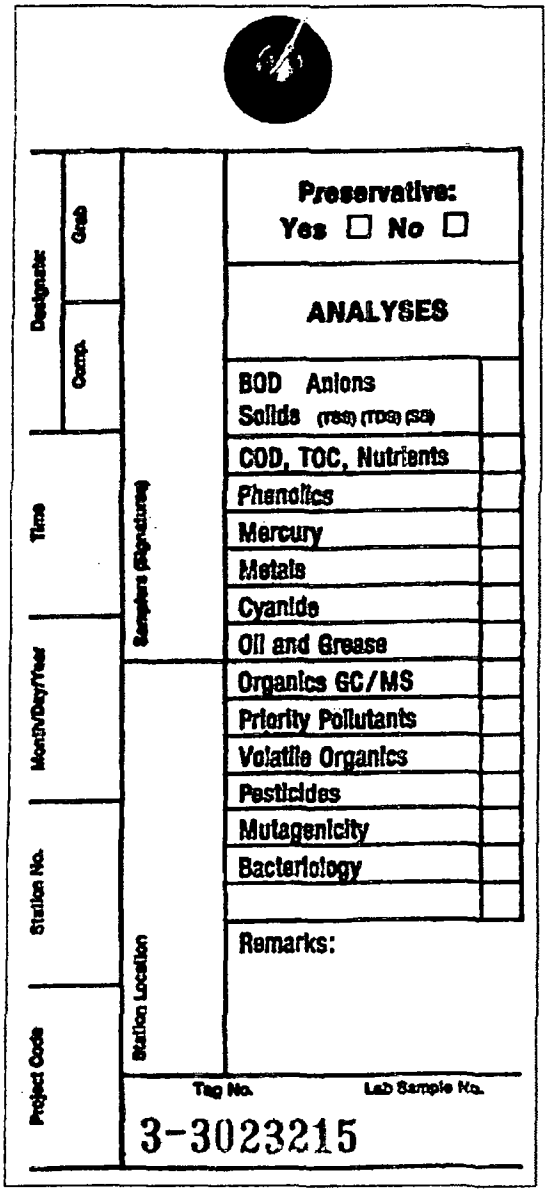
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME
(SIGN)		(SIGN)		(SIGN)		(SIGN)	
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME
(SIGN)		(SIGN)		(SIGN)		(SIGN)	

COMMENTS:

DISTRIBUTION: White and yellow copies accompany sample shipment to laboratory; yellow copy returned by laboratory. Pink copy retained by sampler. 1/93

Note: If requested by the client, different chain-of-custody records may be used. Copies of the template for this record may be obtained from the Chantilly Graphics Department.

Figure 2
Example Sample Tag



Note: Equivalent sample labels or tags may be used.

Packaging and Shipping Environmental Samples

SOP 2-1
Revision: 3
Date: March 2007

Prepared: Krista Lippoldt

Technical Review: Chuck Myers

E-Signed by Michael C. Malloy
VERIFY authenticity with ApproveIt

QA Review: Jo Nell Mullins

Approved:

Signature/Date

E-Signed by P. Michael Schwen
VERIFY authenticity with ApproveIt

Issued:

Signature/Date

1.0 Objective

The objective of this SOP is to outline the requirements for the packaging and shipment of environmental samples. Additionally, Sections 2.0 through 7.0 outline requirements for the packaging and shipping of regulated environmental samples under the Department of Transportation (DOT) Hazardous Materials Regulations, the International Air Transportation Association (IATA), and International Civil Aviation Organization (ICAO) Dangerous Goods Regulations for shipment by air and applies only to domestic shipments. This SOP does not cover the requirements for packaging and shipment of equipment (including data loggers and self-contained breathing apparatus [SCBAs] or bulk chemicals that are regulated under the DOT, IATA, and ICAO.

1.1 Packaging and Shipping of All Samples

This standard operating procedure (SOP) applies to the packaging and shipping of all environmental samples. If the sample is preserved or radioactive, the following sections may also be applicable.

Section 2.0 - Packaging and Shipping Samples Preserved with Methanol
Section 3.0 - Packaging and Shipping Samples Preserved with Sodium Hydroxide
Section 4.0 - Packaging and Shipping Samples Preserved with Hydrochloric Acid
Section 5.0 - Packaging and Shipping Samples Preserved with Nitric Acid
Section 6.0 - Packaging and Shipping Samples Preserved with Sulfuric Acid
Section 7.0 - Packaging and Shipping Limited-Quantity Radioactive Samples

1.2 Background

1.2.1 Definitions

Environmental Sample - An aliquot of air, water, plant material, sediment, or soil that represents the contaminant levels on a site. Samples of potential contaminant sources, like tanks, lagoons, or non-aqueous phase liquids are normally not "environmental" for this purpose. This procedure applies only to environmental samples that contain less than reportable quantities for any foreseeable hazardous constituents according to DOT regulations promulgated in 49 CFR - Part 172.101 Appendix A.

Custody Seal - A custody seal is a narrow adhesive-backed seal that is applied to individual sample containers and/or the container (i.e., cooler) before offsite shipment. Custody seals are used to demonstrate that sample integrity has not been compromised during transportation from the field to the analytical laboratory.

Inside Container - The container, normally made of glass or plastic, that actually contacts the shipped material. Its purpose is to keep the sample from mixing with the ambient environment.

Outside Container - The container, normally made of metal or plastic, that the transporter contacts. Its purpose is to protect the inside container.

Secondary Containment - The outside container provides secondary containment if the inside container breaks (i.e., plastic overpackaging if liquid sample is collected in glass).

Excepted Quantity - Excepted quantities are limits to the mass or volume of a hazardous material in the inside and outside containers below which DOT, IATA, ICAO regulations do not apply. The excepted quantity limits are very low. Most regulated shipments will be made under limited quantity.

Limited Quantity - Limited quantity is the maximum amount of a hazardous material below which there are specific labeling or packaging exceptions.

Performance Testing - Performance testing is the required testing of outer packaging. These tests include drop and stacking tests.

Qualified Shipper - A qualified shipper is a person who has been adequately trained to perform the functions of shipping hazardous materials.

1.2.2 Associated Procedures

- CDM Federal SOP 1-2, *Sample Custody*

1.2.3 Discussion

Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis. These shipments are potentially subject to regulations published by DOT, IATA, or ICAO. Failure to abide by these rules places both CDM and the individual employee at risk of serious fines. The analytical holding times for the samples must not be exceeded. The samples shall be packed in time to be shipped for overnight delivery. Make arrangements with the laboratory before sending samples for weekend delivery.

1.3 Required Equipment

- Coolers with return address of the appropriate CDM office
- Heavy-duty plastic garbage bags
- Plastic zip-type bags, small and large
- Clear tape
- Nylon reinforced strapping tape
- Duct tape
- Vermiculite (or an equivalent nonflammable material that is inert and absorbent)*
- Bubble wrap (optional)
- Ice
- Custody seals
- Completed chain-of-custody record or contract laboratory program (CLP) custody records, if applicable
- Completed bill of lading
- "This End Up" and directional arrow labels

*Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

1.4 Packaging Environmental Samples

The following steps must be followed when packing sample bottles and jars for shipment:

1. Verify the samples undergoing shipment meet the definition of "environmental sample" and are not a hazardous material as defined by DOT. Professional judgment and/or consultation with qualified persons such as the appropriate health and safety coordinator or the health and safety manager shall be observed.

2. Select a sturdy cooler in good repair. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler. Line the cooler with a large heavy-duty plastic garbage bag.

3. Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly (SOP 1-2, Sample Custody).

4. Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Up to three VOA vials may be packed in one bag. Binding the vials together with a rubber band on the outside of the bag, or separating them so that they do not contact each other, will reduce the risk of breakage. Bottles may be wrapped in bubble wrap. Optionally, place three to six VOA vials in a quart metal can and then fill the can with vermiculite or equivalent. ***Note***: Trip blanks must be included in coolers containing VOA samples.

5. Place 2 to 4 inches of vermiculite (or equivalent) into a cooler that has been lined with a garbage bag, and then place the bottles and cans in the bag with sufficient space to allow for the addition of packing material between the bottles and cans. It is preferable to place glass sample bottles and jars into the cooler vertically. Glass containers are less likely to break when packed vertically rather than horizontally.

6. While placing sample containers into the cooler, conduct an inventory of the contents of the shipping cooler against the chain-of-custody record. The chain-of-custody with the cooler shall reflect only those samples within the cooler.

7. Put ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place the ice bags on top of and/or between the samples. Several bags of ice are required (dependant on outdoor temperature, staging time, etc.) to maintain the cooler temperature at approximately 4° Celsius (C) if the analytical method requires cooling. Fill all remaining space between the bottles or cans with packing material. Securely fasten the top of the large garbage bag with fiber or duct tape.

8. Place the completed chain-of-custody record or the CLP traffic report form (if applicable) for the laboratory into a plastic zip-top bag, seal the bag, tape the bag to the inner side of the cooler lid and close the cooler.

9. The cooler lid shall be secured with nylon reinforced strapping tape by wrapping each end of the cooler a minimum of two times. Attach a completed chain-of-custody seal across the opening of the cooler on opposite sides. The custody seals shall be affixed to the cooler with half of the seal on the strapping tape so that the cooler cannot be opened without breaking the seal. Complete two more wraps around with fiber tape and place clear tape over the custody seals.

10. The shipping container lid must be marked **"THIS END UP"** and arrow labels that indicate the proper upward position of the container shall be affixed to the cooler. A label containing the name and address of the shipper (CDM) shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted on the outside of containers used to transport environmental samples and shall not be used. The name and address of the laboratory shall be placed on the container, or when shipping by common courier, the bill of lading shall be completed and attached to the lid of the shipping container.

2.0 Packaging and Shipping Samples Preserved with Methanol

2.1 Containers

- The maximum volume of methanol in a sample container is limited to 30 ml.
- The sample container must not be full of methanol.

2.2 Responsibility

It is the responsibility of the qualified shipper to:

- Ensure that the samples undergoing shipment contain no other contaminant that meets the definition of "hazardous material" as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

2.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packing may consist of glass or plastic jars
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
- Survey documentation (if shipping from Department of Energy [DOE] or radiological sites)
- Class 3 flammable liquid labels
- Orientation labels
- Consignor/consignee labels

2.4 Packaging Samples Preserved with Methanol

The following steps are to be followed when packaging limited-quantity sample shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place wrapped containers inside a polyethylene bottle filled with vermiculite; seal the bottle. (Maximum of 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)
- Total volume of methanol per shipping container must not exceed 500 ml.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

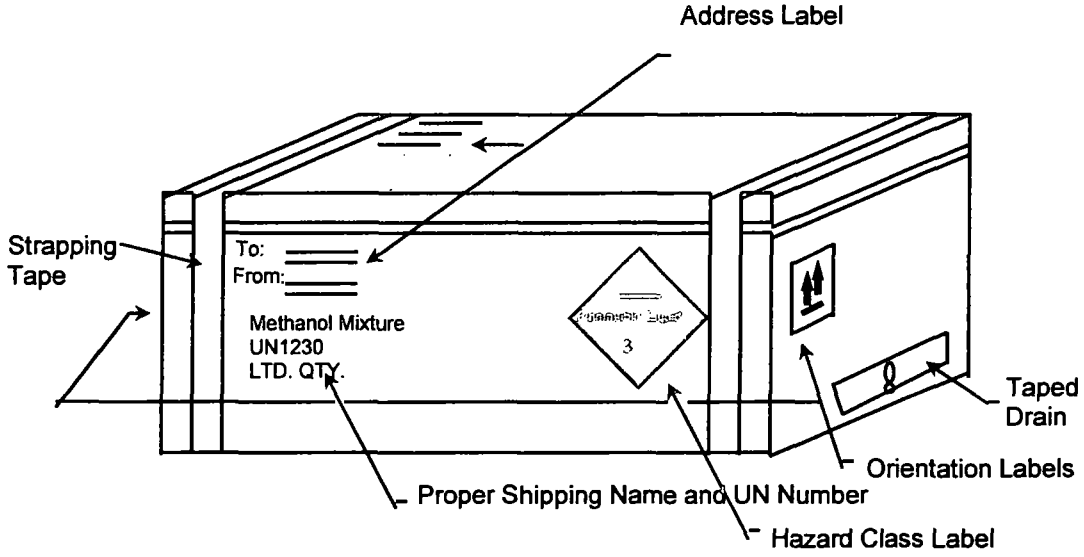
  Methanol Mixture
  UN1230
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Flammable Liquid label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: No marking or labeling can be obscured by strapping or duct tape.
Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

Figure 1
Example of Cooler Label/Marking Locations



3.0 Packaging and Shipping Samples Preserved with Sodium Hydroxide

3.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Sodium Hydroxide Preservatives

Preservative		*Desired in Final Sample*		*Quantity of Preservative (ml) for Specified Container*				
		pH	**Conc.**	**40 ml**	**125 ml**	**250 ml**	**500 ml**	**1 L**
NaOH	30%	>12	0.08%		.25	0.5	1	2

5 drops = 1 ml

3.2 Responsibility

It is the responsibility of the qualified shipper to determine the amount of preservative in each sample so that accurate determination of quantities can be made.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

3.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
- Inner packings may consist of glass or plastic jars no larger than 1 pint
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

3.4 Packaging Samples Preserved with Sodium Hydroxide

Samples containing NaOH as a preservative that exceed the excepted concentration of 0.08 percent (2 ml of a 30 percent NaOH solution per liter) may be shipped as a limited quantity per packing instruction Y819 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- The total volume of sample in each cooler must not exceed 1 liter.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

  Sodium Hydroxide Solution
  UN1824
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples meeting the exception concentration of 0.08 percent NaOH by weight may be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

4.0 Packaging and Shipping Samples Preserved with Hydrochloric Acid

4.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Hydrochloric Acid Preservatives

Preservative		*Desired in Final Sample*		*Quantity of Preservative (ml) for Specified Container*		
		pH	**Conc.**	**40 ml**	**125 ml**	**250 ml**
HCl	2N	<1.96	0.04%	.2	.5	1

5 drops = 1 ml

4.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

4.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3.

- Inner packing may consist of glass or plastic jars no larger than 1 pint.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

4.4 Packaging Samples Preserved with Hydrochloric Acid

The following steps are to be followed when packaging limited-quantity sample shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place wrapped containers inside a polyethylene bottle filled with vermiculite; seal the bottle. (No more than 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)

- Total volume of sample inside each cooler must not exceed 1 liter.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

  Hydrochloric Acid Solution
  UN1789
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples containing less than the exception concentration of 0.04 percent HCl by weight will be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

5.0 Packaging and Shipping Samples Preserved with Nitric Acid

5.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Nitric Acid Preservatives

Preservative		*Desired in Final Sample*		*Quantity of Preservative (ml) for Specified Container*				
		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
HNO_3	6N	<1.62	0.15%		2	4	5	8

5 drops = 1 mg/L

5.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

5.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

5.4 Packaging Samples Preserved with Nitric Acid

Samples containing HNO_3 as a preservative that exceed the excepted concentration of 0.15 percent HNO_3 will be shipped as a limited quantity per packing instruction Y807 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity sample shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum volume of preserved solution in the cooler must not exceed 500 ml.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

Nitric Acid Solution (with less than 20 percent)
UN2031
Ltd. Qty.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: *Samples meeting the exception concentration of 0.15 percent HNO_3 by weight will be shipped as nonregulated or* nonhazardous following the procedure in Section 1.4.

Note: *No marking or labeling can be obscured by strapping or duct tape.*

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other *nonregulated environmental samples may be added to the cooler for shipment.*

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

6.0 Packaging and Shipping Samples Preserved with Sulfuric Acid

6.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Sulfuric Acid Preservatives

Preservative		*Desired in Final Sample*		*Quantity of Preservative (ml) for Specified Container*				
		pH	**Conc.**	**40 ml**	**125 ml**	**250 ml**	**500 ml**	**1 L**
H_2SO_4	37N	<1.15	0.35%	.1	.25	0.5	1	2

5 drops = 1 ml

6.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

6.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

6.4 Packaging of Samples Preserved with Sulfuric Acid

Samples containing H_2SO_4 as a preservative that exceed the excepted concentration of 0.35 percent will be shipped as a limited quantity per packing instruction Y809 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each glass container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum volume of preserved solution in the cooler must not exceed 500 ml.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

  Sulfuric Acid Solution
  UN2796
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples containing less than the exception concentration of 0.35 percent H_2SO_4 by weight will be shipped as nonregulated or nonhazardous in accordance with the procedure described in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

7.0 Packaging and Shipping Limited-Quantity Radioactive Samples

7.1 Containers

The inner packaging containers that may be used for these shipments include:

- Any size sample container

7.2 Description/Responsibilities

- The qualified shipper will determine that the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT.
- The qualified shipper will ship all samples that meet the Class 7 definition of radioactive materials and meet the activity requirements specified in Table 7 of 49 CFR 173.425, as Radioactive Materials in Limited Quantity. The qualified shipper will verify that all packages and their contents meet the requirements of 49 CFR 173.421, *Limited Quantities of Radioactive Materials.*
- The packaging used for shipping will meet the general requirements for packaging and packages specified in 49 CFR 173.24 and the general design requirements provided in 173.410. These standards state that a package must be capable of withstanding the effects of any acceleration, vibration, or vibration resonance that may arise under normal condition of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use.
- If the shipment is from a DOE facility, radiological screenings will be completed on all samples taken. The qualified shipper will review the results of each screening (alpha, beta, and gamma speciation). Samples will not be shipped offsite until the radiological screening has been performed.
- The total activity for each package will not exceed the relevant limits listed in Table 7 of 49 CFR 173.425. The A_2 value of the material will be calculated based on all radionuclides found during previous investigations (if any) in the area from which the samples are derived. The A_2 values to be used will be the most restrictive of all potential radionuclides as listed in 49 CFR 173.435.
- The radiation level at any point on the external surface of the package bearing the sample(s) will not exceed 0.005 mSv/hour (0.5 mrem/hour). These will be verified by dose and activity monitoring before shipment of the package.
- The removable radioactive surface contamination on the external surface of the package will not exceed the limits specified in 49 CFR 173.443(a). CDM will apply the DOE-established free release criteria for removable surface contamination of less than 20 dpm/100 cm^2 (alpha) and 1,000 dpm/100 cm^2 (beta/gamma). It shall be noted that these values are more conservative than the DOT requirements for removable surface contamination.
- The qualified shipper will verify that the outside of the inner packaging is marked "Radioactive."
- The qualified shipper will verify that the excepted packages prepared for shipment under the provisions of 49 CFR 173.421 have a notice enclosed, or shown on the outside of the package, that reads, **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

7.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Survey documentation/radiation screening results (if shipping from DOE or radiological sites)
- Orientation labels
- *Excepted quantities label*
- Consignor/consignee labels

7.4 Packaging of Limited-Quantity Radioactive Samples

The following steps are to be followed when packaging limited-quantity sample shipments:

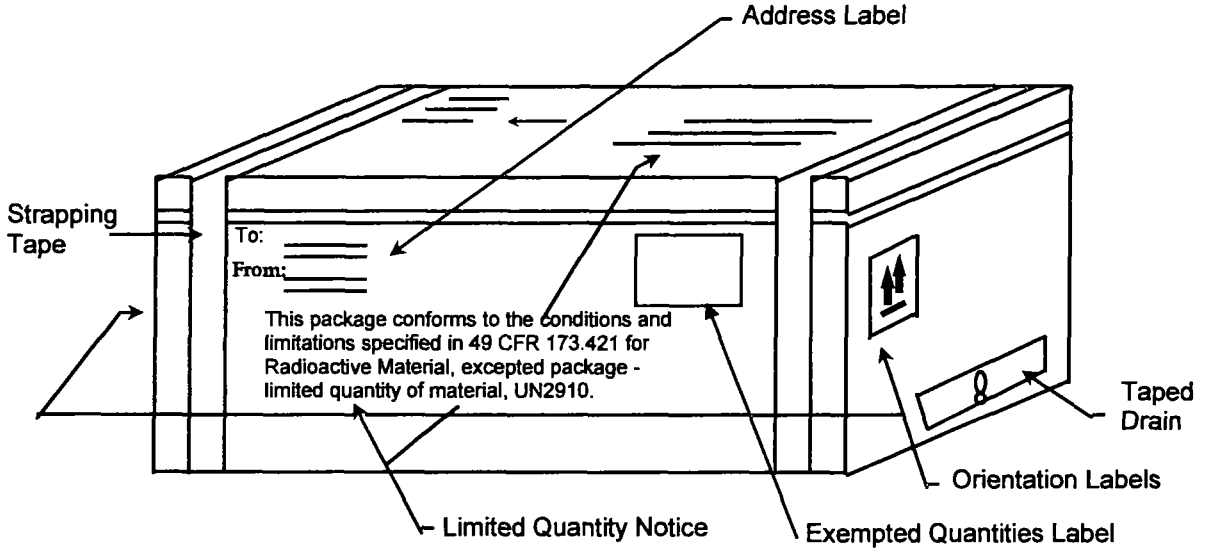
- The cooler is to be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - *Project number*
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place sufficient amount of vermiculite, or approved packaging material, in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- If required, place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- Place a label marked Radioactive on the outside of the sealed bag.
- Enclose a notice that includes the name of the consignor or consignee and the following statement: ***"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."***
- Note that both DOT and IATA apply different limits to the quantity in the inside packing and in the outside packing.
- The maximum weight of the package shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- If a cooler is used, wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix package orientation labels on two opposite sides of the cooler/package.
- Affix a completed Excepted Quantities label to the side of the cooler/package.
- Secure any marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of the cooler labeling/marking is shown in Figure 2.

Note: No marking or labeling can be obscured by strapping or duct tape.

- Complete the Shipment Quality Assurance Checklist (Appendix B).

Note: Except as provided in 49 CFR 173.426, the package will not contain more than 15 grams of ^{235}U.
Note: A declaration of dangerous goods is not required.

Figure 2
Radioactive Material – Limited-Quantity Cooler Marking Example



8.0 References

U. S. Environmental Protection Agency. Region IV. February 1991 or current. *Standard Operating Procedures and Quality Assurance Manual.*

_____. 1996 or current. *Sampler's Guide to the Contract Laboratory Program*, EPA/540/R-96/032.

Title 49 Code of Federal Regulations, Department of Transportation. 2005 or current revision. *Hazardous Materials Table, Special Provisions, Hazardous, Materials Communications, Emergency Response Information, and Training Requirements*, 49 CFR 172.

Title 49 Code of Federal Regulations, Department of Transportation. 2005 or current revision. *Shippers General Requirements for Shipments and Packagings*, 49 CFR 173.

Appendix A

Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity

Sample Packaging

Yes	No	N/A	
❑	❑	❑	The VOA vials are wrapped in bubble wrap and placed inside a zip-type bag.
❑	❑	❑	The VOA vials are placed into a polyethylene bottle, filled with vermiculite, and tightly sealed.
❑	❑	❑	The drain plug is taped inside and outside to ensure control of interior contents.
❑	❑	❑	The samples have been placed inside garbage bags with sufficient bags of ice to preserve samples at 4°C.
❑	❑	❑	The cooler weighs less than the 66-pound limit for limited-quantity shipment.
❑	❑	❑	The garbage bag has been sealed with tape (or tied) to prevent movement during shipment.
❑	❑	❑	The chain-of-custody has been secured to the interior of the cooler lid.
❑	❑	❑	The cooler lid and sides have been taped to ensure a seal.
❑	❑	❑	The custody seals have been placed on both the front and back hinges of the cooler, using waterproof tape.

Air Waybill Completion

Yes	No	N/A	
❑	❑	❑	Section 1 has the shipper's name, company, and address; the account number, date, internal billing reference number; and the telephone number where the shipper can be reached.
❑	❑	❑	Section 2 has the recipient's name and company along with a telephone number where they can be reached.
❑	❑	❑	Section 3 has the **Bill Sender** box checked.
❑	❑	❑	Section 4 has the **Standard Overnight** box checked.
❑	❑	❑	Section 5 has the **Deliver Weekday** box checked.
❑	❑	❑	Section 6 has the number of packages and their weights filled out. Was the total of all packages and their weights figured up and added at the bottom of Section 6?
❑	❑	❑	Under the **Transport Details** box, the **Cargo Aircraft Only** box is obliterated, leaving only the **Passenger and Cargo Aircraft** box.
❑	❑	❑	Under the **Shipment Type**, the **Radioactive** box is obliterated, leaving only the **Non-Radioactive** box.
❑	❑	❑	Under the **Nature and Quantity of Dangerous Goods** box, the **Proper Shipping Name, Class or Division, UN or ID No., Packing Group, Subsidiary Risk, Quantity and Type of Packing, Packing Instructions, and Authorization** have been filled out for the type of chemical being sent.
❑	❑	❑	The **Name, Place and Date, Signature, and Emergency Telephone Number** appears at the bottom of the FedEx Airbill.
❑	❑	❑	The statement "In accordance with IATA/ICAO" appears in the **Additional Handling Information** box.
❑	❑	❑	The **Emergency Contact Information** at the bottom of the FedEx Airbill is truly someone who can respond any time of the day or night.

Proper Shipping Name	*Class or Division*	*UN or ID No.*	*Packing Group*	*Sub Risk*	*Quantity*	*Packing Instruction*	*Authorization*
Hydrochloric Acid Solution	8	UN1789	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Nitric Acid Solution (with less than 20%)	8	UN2031	II		1 plastic box × 0.5 L	Y807	Ltd. Qty.
Sodium Hydroxide Solution	8	UN1824	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Sulfuric Acid Solution	8	UN2796	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Methanol	3	UN1230	II		1 plastic box × 1 L	Y305	Ltd. Qty.

Sample Cooler Labeling

Yes	No	N/A	
❑	❑	❑	The proper shipping name, UN number, and Ltd. Qty. appears on the shipping container.
❑	❑	❑	The corresponding hazard labels are affixed on the shipping container; the labels are not obscured by tape.
❑	❑	❑	The name and address of the shipper and receiver appear on the top and side of the shipping container.
❑	❑	❑	The air waybill is attached to the top of the shipping container.
❑	❑	❑	**Up Arrows** have been attached to opposite sides of the shipping container.
❑	❑	❑	Packaging tape does not obscure markings or labeling.

Appendix B
Shipment Quality Assurance Checklist

Date: _____ Shipper: _____ Destination: _____

Item(s) Description: _____

Radionuclide(s): _____

Radiological Survey Results: surface _____mrem/hr 1 meter _____

Instrument Used: Mfgr: _____ Model: _____

S/N: _____ Cal Date: _____

Limited-Quantity or Instrument and Article

Yes	No		
___	___	1.	Strong tight package (package that will not leak material during conditions normally incidental to transportation).
___	___	2.	Radiation levels at any point on the external surface of package less than or equal to 0.5 mrem/hr.
___	___	3.	Removable surface contamination less than 20 dpm/100 cm^2 (alpha) and 1,000 dpm/100 cm^2 (beta/gamma).
___	___	4.	Outside inner package bears the marking "Radioactive."
___	___	5.	Package contains less than 15 grams of ^{235}U (check yes if ^{235}U not present).
___	___	6.	Notice enclosed in or on the package that includes the consignor or consignee and the statement, **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**
___	___	7.	Activity less than that specified in 49 CFR 173.425. Permissible package limit: Package Quantity:
___	___	8.	On all air shipments, the statement **Radioactive Material, excepted package-limited quantity of material** shall be noted on the air waybill.

Qualified Shipper: _____ Signature: _____

Guide to Handling Investigation-Derived Waste

SOP 2-2
Revision: 5
Date: March 2007

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Technical Review: Matt Brookshire

E-Signed by Michael C. Malloy
VERIFY authenticity with ApproveIt

QA Review: Jo Nell Mullins

Approved:

Signature/Date

E-Signed by P. Michael Schwan
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Issued:

Signature/Date

1.0 Objective

This standard operating procedure (SOP) presents guidance for the management of investigation-derived waste (IDW). The primary objectives for managing IDW during field activities include:

- Leaving the site in no worse condition than existed before field activities
- Removing wastes that pose an immediate threat to human health or the environment
- Proper handling of onsite wastes that do not require offsite disposal or extended aboveground containerization
- Complying with federal, state, local, and facility applicable or relevant and appropriate requirements (ARARs)
- Careful planning and coordination of IDW management options
- Minimizing the quantity of IDW

2.0 Background

2.1 Definitions

Hazardous Waste - Discarded material that is regulated listed waste, or waste that exhibits ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.3 or state regulations.

Investigation-Derived Wastes - Discarded materials resulting from field activities such as sampling, surveying, drilling, excavations, and decontamination processes that, in present form, possess no inherent value or additional usefulness without treatment. Wastes may be solid, sludge, liquid, gaseous, or multiphase materials that may be classified as hazardous or nonhazardous.

Mixed Waste - Any material that has been classified as hazardous and radioactive.

Radioactive Wastes - Discarded materials that are contaminated with radioactive constituents with specific activities in concentrations greater than the latest regulatory criteria (i.e., 10 CFR 20).

Treatment, Storage, and Disposal Facility (TSDF) - Permitted facilities that accept hazardous waste shipments for further treatment, storage, and/or disposal. These facilities must be permitted by the U. S. Environmental Protection Agency (EPA) and appropriate state and local agencies.

2.2 Discussion

Field investigation activities result in the generation of waste materials that may be characterized as hazardous or radioactive waste. IDWs may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues from testing of treatment technologies and pump and treat systems; personal protective equipment (PPE); solutions (aqueous or otherwise) used to decontaminate nondisposable protective clothing and equipment; and other wastes or supplies used in sampling and testing potentially hazardous or radiologically contaminated material.

Note: The client's representatives may not be aware of all potential contaminants. The management of IDW must comply with applicable regulatory requirements.

3.0 General Responsibilities

Site Manager - The site manager is responsible for ensuring that all IDW procedures are conducted in accordance with this SOP. The site manager is also responsible for ensuring that handling of IDW is in accordance with site-specific requirements.

Project Manager - The project manager is responsible for identifying site-specific requirements for the disposal of IDW in accordance with federal, state, and/or facility requirements.

Field Crew Members - Field crew members are responsible for implementing this SOP and communicating any unusual or unplanned condition to the project manager's attention.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/project specific quality assurance plan.

4.0 Required Equipment

Equipment required for IDW containment will vary according to site-specific/client requirements. Management decisions concerning the necessary equipment required shall consider: containment method, sampling, labeling, maneuvering, and storage (if applicable). Equipment must be onsite and inspected before commencing work.

4.1 IDW Containment Devices

The appropriate containment device (drums, tanks, etc.) will depend on site- or client-specific requirements and the ultimate disposition of the IDW. Typical IDW containment devices can include:

- Plastic sheeting (polyethylene) with a minimum thickness of 20 millimeters
- Department of Transportation (DOT)-approved steel containers
- Polyethylene or steel bulk storage tanks

Containment of IDW shall be segregated by waste type (i.e., solid or liquid, corrosive or flammable, etc.) and source location. Volume of the appropriate containment device shall be site-specific.

4.2 IDW Container Labeling

A "Waste Container" or "IDW Container" label or indelible marking shall be applied to each container. Labeling or marking requirements for onsite IDW not expected to be transported offsite are:

- Labels and markings that contain the following information: project name, generation date, location of waste origin, container identification number, sample number (if applicable), and contents (drill cuttings, purge water, PPE, etc.).
- Each label or marking will be applied to the upper one-third of the container at least twice, on opposite sides.
- Containers that are 5 gallons or less may only require one label or set of markings.
- Labels or markings will be positioned on a smooth part of the container. The label must not be affixed across container bungs, seams, ridges, or dents.
- Labels must be constructed of a weather-resistive material with markings made with a permanent marker or paint pen and capable of enduring the expected weather conditions. If markings are used, the color must be easily distinguishable from the drum color.
- Labels will be secured in a manner to ensure the label remains affixed to the container.

Labeling or marking requirements for IDW expected to be transported offsite must be in accordance with the requirements of 49 CFR 172.

4.3 IDW Container Movement

Staging areas for IDW containers shall be predetermined and in accordance with site-specific and/or client requirements. Arrangements shall be made before field mobilization as to the methods and personnel required to safely transport IDW containers to the staging area. Transportation offsite onto a public roadway is prohibited unless 49 CFR 172 requirements are met.

4.4 IDW Container Storage

Containerized IDW shall be staged pending chemical analysis or further onsite treatment. Staging areas and bulk storage procedures are to be determined according to site-specific requirements. Containers are to be stored in such a fashion that the labels can be easily read. A secondary/spill container must be provided for liquid IDW storage and as appropriate for solid IDW storage.

5.0 Procedures

The three general options for managing IDW are (1) collection and onsite disposal, (2) collection for offsite disposal, and (3) collection and interim management. Attachment 1 summarizes media-specific information on generation processes and management options. The option selected shall take into account the following factors:

- Type (soil, sludge, liquid, debris), quantity, and source of IDW
- Risk posed by managing the IDW onsite
- Compliance with regulatory requirements
- IDW minimization and consistency with the IDW remedy and the site remedy

In all cases the client shall approve the plans for IDW. Formal plans for the management of IDW must be prepared as part of a work plan or separate document.

5.1 Collection and Onsite Disposal

5.1.1 Soil/Sludge/Sediment

The options for handling soil/sludge/sediment IDW are as follows:

1. Return to boring, pit, or source immediately after generation as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas).

2. Spread around boring, pit, or source within the area of contamination (AOC) as long as returning the media to these areas will not increase site risks (e.g., direct contact with surficial contamination).

3. Consolidate in a pit within the AOC as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas).

4. Send to onsite TSDF - may require analytical analysis before treatment/disposal.

Note: These options may require client and/or regulatory approval.

5.1.2 Aqueous Liquids

The options for handling aqueous liquid IDW are as follows:

1. Discharge to surface water, only when IDW is not contaminated.

2. Discharge to ground surface close to the well, only if soil contaminants will not be mobilized in the process and the action will not contaminate clean areas. If IDW from the sampling of background upgradient wells is not a community concern or associated with soil contamination, this presumably uncontaminated IDW may be released on the ground around the well.

3. Discharge to sanitary sewer, only when IDW is not contaminated.

4. Send to onsite TSDF - may require analysis before treatment/disposal.

Note: These options may require analytical results to obtain client and/or regulatory approval.

5.1.3 Disposable PPE

The options for handling disposable PPE are as follows:

1. Double-bag contents in nontransparent trash bags and place in onsite industrial dumpster, only if PPE is not contaminated.

2. Containerize, label, and send to onsite TSDF - may require analysis before treatment/disposal.

5.2 Collection for Offsite Disposal

Before sending to an offsite TSDF, analysis may be required. Manifests are required. In some instances, a bill of lading can be used for nonhazardous solid IDW (i.e., wooden pallets, large quantities of plastic sheeting). Arrangements must be made with the client responsible for the site to sign as generator on any waste profile and all manifests or bill of ladings; it is CDM's policy not to sign manifests. The TSDF and transporter must be permitted for the respective wastes. Nonbulk containers (e.g., drums) must have a DOT-approved label adhered to the container and all required associated placard stickers before leaving for a TSDF off site. These labels must include information as required in 49 CFR 172. Bulk containers (i.e., rolloffs, tanks) do not require container specific labels for transporting off site, but must include appropriate placards as required in 49 CFR 172.

5.2.1 Soil/Sludge/Sediment

When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., drummed, covered in a waste pile) or returned to its source until final disposal. The management option selected shall take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.2 Aqueous Liquids

When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., mobile tanks or drums with appropriate secondary containment) until final disposal. The management option selected shall take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.3 Disposable PPE

When the final site remedy requires offsite treatment disposal, the IDW may be containerized and stored. The management option selected shall take into account potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.3 Collection and Interim Management

All interim measures must be approved by the client and regulatory agencies.

1. Storing IDW onsite until the final action may be practical in the following situations:
   - Returning wastes (especially sludges and soils) to their onsite source area would require reexcavation for disposal in the final remediation alternative.
   - Interim storage in containers may be necessary to provide adequate protection to human health and the environment.
   - Offsite disposal options may trigger land disposal regulations under the Resource Conservation and Recovery Act (RCRA). Storing IDW until the final disposal of all wastes from the site will eliminate the need to address this issue more than once.
   - Interim storage may be necessary to provide time for sampling and analysis.

2. Segregate and containerize all waste for future treatment and/or disposal.
   - Containment options for soil/sludge/sediment may include drums or covered waste piles in AOC.
   - Containment options for aqueous liquids may include mobile tanks or drums.
   - Containment options for PPE may include drums or roll-off boxes.

6.0 Restrictions/Limitations

Site Managers Shall Determine the Most Appropriate Disposal Option for Aqueous Liquids on a Site-Specific Basis. Parameters to consider, especially when determining the level of protection, include the volume of IDW, the contaminants present in the groundwater, the presence of contaminants in the soil at the site, whether the groundwater or surface water is a drinking water supply, and whether the groundwater plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components.

Disposable sampling materials, disposable PPE, decontamination fluids, etc. will always be managed on a site-specific basis. **Under No Circumstances Shall These Types of Materials Be Brought Back to the Office or Warehouse.**

7.0 References

Environmental Resource Center. 1997. *Hazardous Waste Management Compliance Handbook 2nd Edition.* Karnofsky (Editor).

Academy of Certified Hazardous Materials Manager. May 1999. *Hazardous Materials Management Desk Reference.* Cox.

Title 49 Code of Federal Regulations, Department of Transportation. 2005 or current revision. *Hazardous Materials Table, Special Provisions, Hazardous, Materials Communications, Emergency Response Information, and Training Requirements*, 49 CFR 172.

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_____. Region IV. November 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.*

Attachment 1
IDW Management Options

Type of IDW	*Generation Processes*	*Management Options*
Soil	■ Well/Test pit installations ■ Borehole drilling ■ Soil sampling	**Onsite Disposal** ■ Return to boring, pit, or source immediately after generation ■ Spread around boring, pit, or source within the AOC ■ Consolidate in a pit (within the AOC) ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite TSDF **Interim Management** ■ Store for future treatment and/or disposal
Sludge/Sediment	■ Sludge pit/sediment sampling	**Onsite Disposal** ■ Return to boring, pit, or source immediately after generation ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite TSDF **Interim Management** ■ Store for future treatment and/or disposal
Aqueous Liquids (groundwater, surface water, drilling fluids, wastewaters)	■ Well installation/development ■ Well purging during sampling ■ Groundwater discharge during pump tests ■ Surface water sampling ■ Wastewater sampling	**Onsite Disposal** ■ Pour onto ground close to well (nonhazardous waste) ■ Discharge to sewer ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite commercial treatment unit ■ Client to send to publicly owned treatment works (POTW) **Interim Management** ■ Store for future treatment and/or disposal
Decontamination Fluids	■ Decontamination of PPE and equipment	**Onsite Disposal** ■ Send to onsite TSDF ■ Evaporate (for small amounts of low contamination organic fluids) ■ Discharge to ground surface **Offsite Disposal** ■ Client to send to offsite TSDF ■ Discharge to sewer **Interim Management** ■ Store for future treatment and/or disposal
Disposable PPE and Sampling Equipment	■ Sampling procedures or other onsite activities	**Onsite Disposal** ■ Place in onsite industrial dumpster ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite TSDF **Interim Management** ■ Store for future treatment and/or disposal

Adapted from U. S. Environmental Protection Agency, *Guide to Management of Investigation-Derived Wastes*, 9345-03FS, January 1992.

Field Logbook Content and Control

SOP 4-1
Revision: 6
Date: March 2007

Prepared: Del Baird

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Issued:

Signature/Date

1.0 Objective

The objective of this standard operating procedure (SOP) is to set CDM Federal (CDM) criteria for content entry and form of field logbooks. Field logbooks are an essential tool to document field activities for historical and legal purposes.

2.0 Background

2.1 Definitions

Biota - The flora and fauna of a region.

Magnetic Declination Corrections - Compass adjustments to correct for the angle between magnetic north and geographical meridians.

2.2 Discussion

Information recorded in field logbooks includes field team names; observations; data; calculations; date/time; weather; and description of the data collection activity, methods, instruments, and results. Additionally, the logbook may contain deviations from plans and descriptions of wastes, biota, geologic material, and site features including sketches, maps, or drawings as appropriate.

3.0 General Responsibilities

Field Team Leader (FTL) - The FTL is responsible for ensuring that the format and content of data entries are in accordance with this procedure.

Site Personnel - All CDM employees who make entries in field logbooks during onsite activities are required to read this procedure before engaging in this activity. The FTL will assign field logbooks to site personnel who will be responsible for their care and maintenance. Site personnel will return field logbooks to the records file at the end of the assignment.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities should be defined in the field plan or site-/project-specific quality assurance plan.

4.0 Required Equipment

- Site-specific plans
- Field logbook
- Indelible black or blue ink pen
- Ruler or similar scale

5.0 Procedures

5.1 Preparation

In addition to this SOP, site personnel responsible for maintaining logbooks must be familiar with all procedures applicable to the field activity being performed. These procedures should be consulted as necessary to obtain specific information about equipment and supplies, health and safety, sample collection, packaging, decontamination, and documentation. These procedures should be located at the field office or vehicle for easy reference.

Field logbooks shall be bound with lined, consecutively numbered pages. All pages must be numbered before initial use of the logbook. Before use in the field, each logbook will be marked with a specific document control number issued by

the document control administrator, if required by the contract quality implementation plan (QIP). Not all contracts require document control numbers. The following information shall be recorded on the cover of the logbook:

- Field logbook document control number (if applicable).
- Activity (if the logbook is to be activity-specific), site name, and location.
- Name of CDM contact and phone number(s) (typically the project manager).
- Start date of entries.
- End date of entries.
- In specific cases, special logbooks may be required (e.g., waterproof paper for stormwater monitoring).

The first few (approximately five) pages of the logbook will be reserved for a table of contents (TOC). Mark the first page with the heading and enter the following:

Table of Contents

Date/Description	Pages
(Start Date)/Reserved for TOC	1-5

The remaining pages of the table of contents will be designated as such with "TOC" written on the top center of each page. The table of contents should be completed as activities are completed and before placing the logbook in the records file.

5.2 Operation

Requirements that must be followed when using a logbook:

- Record work, observations, quantities of materials, calculations, drawings, and related information directly in the logbook. If data collection forms are specified by an activity-specific plan, this information does not need to be duplicated in the logbook. However, any forms used to record site information must be referenced in the logbook.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Do not erase or blot out any entry at any time. Indicate any deletion by a single line through the material to be deleted. Initial and date each deletion. Take care to not obliterate what was written previously.
- Do not remove any pages from the book.

Specific requirements for field logbook entries include:

- Initial and date each page.
- Sign and date the final page of entries for each day.
- Initial and date all changes.
- Multiple authors must sign out the logbook by inserting the following:
  Above notes authored by:
  - (Sign name)
  - (Print name)
  - (Date)
- A new author must sign and print his/her name before additional entries are made.
- Draw a diagonal line through the remainder of the final page at the end of the day.
- Record the following information on a daily basis:
  - Date and time
  - Name of individual making entry
  - Names of field team and other persons onsite
  - Description of activity being conducted including station or location (i.e., well, boring, sampling location number) if appropriate
  - Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
  - Level of personal protection used
  - Serial numbers of instruments
  - Equipment calibration information
  - Serial/tracking numbers on documentation (e.g., carrier air bills)

Entries into the field logbook shall be preceded with the time (written in military units) of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form required by an operating procedure. In these cases, the logbook must reference the automatic data record or form.

At each station where a sample is collected or an observation or measurement made, a detailed description of the location of the station is required. Use a compass (include a reference to magnetic declination corrections), scale, or nearby survey markers, as appropriate. A sketch of station location may be warranted. All maps or sketches made in the logbook should have descriptions of the features shown and a direction indicator. It is preferred that maps and sketches be oriented so that north is toward the top of the page. Maps, sketches, figures, or data that will not fit on a logbook page should be referenced and attached to the logbook to prevent separation.

Other events and observations that should be recorded include:

- Changes in weather that impact field activities.
- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation.
- Problems, downtime, or delays.
- Upgrade or downgrade of personal protection equipment.
- Visitors to the site.

5.3 Post-Operation

To guard against loss of data as a result of damage or disappearance of logbooks, completed pages shall be periodically photocopied (weekly, at a minimum) and forwarded to the field or project office. Other field records shall be photocopied and submitted regularly and as promptly as possible to the office. When possible, electronic media such as disks and tapes should be copied and forwarded to the project office.

At the conclusion of each activity or phase of site work, the individual responsible for the logbook will ensure that all entries have been appropriately signed and dated and that corrections were made properly (single lines drawn through incorrect information, then initialed and dated). The completed logbook shall be submitted to the records file.

6.0 Restrictions/Limitations

Field logbooks constitute the official record of onsite technical work, investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by CDM personnel and their subcontractors. They are documents that may be used in court to indicate dates, personnel, procedures, and techniques employed during site activities. Entries made in these logbooks should be factual, clear, precise, and nonsubjective. Field logbooks, and entries within, are not to be used for personal use.

7.0 References

Sandia National Laboratories. 1991. *Procedure for Preparing Sampling and Analysis Plan, Site-Specific Sampling Plan, and Field Operating Procedures,* QA-02-03. Albuquerque Environmental Program, Department 3220, Albuquerque, New Mexico.

Sandia National Laboratories. 1992. *Field Operation Procedure for Field Logbook Content and Control.* Environmental Restoration Department, Division 7723, Albuquerque, New Mexico.

Field Equipment Decontamination at Nonradioactive Sites

SOP 4-5
Revision: 7
Date: March 2007

Prepared: Steven Fundingsland

Technical Review: Mike Higman

E-Signed by Michael C. Malloy
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Issued: *Signature/Date*

1.0 Objective

The objective of this standard operating procedure (SOP) is to describe the general procedures required for decontamination of field equipment at nonradioactive sites. This SOP serves as a general guide and is applicable at most sites; however, it shall be noted that site-specific conditions (i.e., type of contamination, type of media sampled), the governing agency (e.g., EPA, DOE, USACE), and site-specific work plans, sampling and analysis plans and/or quality assurance (QA) project plans may require modifications to the decontamination procedures provided in this SOP. Decontamination of field equipment is necessary to ensure acceptable quality of samples by preventing cross contamination. Further, decontamination reduces health hazards and prevents the spread of contaminants offsite.

2.0 Background

2.1 Definitions

Acid Rinse - A solution of 10 percent nitric or hydrochloric acid made from reagent grade acid and analyte-free water.

Analyte-Free Water - Tap water that has been treated so that the water contains no detectable heavy metals or other inorganic compounds. Analyte-free water shall be stored only in clean glass, stainless steel, or plastic containers that can be closed when not in use.

Clean - Free of contamination and when decontamination has been completed in accordance with this SOP.

Cross Contamination - The transfer of contaminants through equipment or personnel from the contamination source to less contaminated or noncontaminated samples or areas.

Decontamination - The process of rinsing or otherwise cleaning the surfaces of equipment to rid them of contaminants and to minimize the potential for cross contamination of samples or exposure of personnel.

Material Safety Data Sheets (MSDS) - These documents discuss the proper storage and physical and toxicological characteristics of a particular substance used during decontamination. These documents, generally included in site health and safety plans, shall be kept on site at all times during field operations.

Organic-Free/Analyte-Free Water - Tap water that has been treated so that the water meets the analyte-free water criteria and contains no detectable organic compounds. Organic-free/analyte-free water shall be stored only in clean glass, Teflon™, or stainless steel containers that can be closed when not in use.

Potable Water - Tap water may be obtained from any municipal system. Chemical analysis of the water source may be required before it is used.

Sampling Equipment - Equipment that comes into direct contact with the sample media. Such equipment includes split spoon samplers, well casing and screens, and spatulas or bowls used to homogenize samples.

Soap - Low-sudsing, nonphosphate detergent such as Liquinox™.

Solvent Rinse - Pesticide grade, or better, isopropanol, acetone, or methanol.

2.2 Associated Procedures

- CDM Federal SOP 1-1 - *Surface Water Sampling*
- CDM Federal SOP 1-3 - *Surface Soil Sampling*
- CDM Federal SOP 1-4 - *Subsurface Soil Sampling*
- CDM Federal SOP 1-5 - *Groundwater Sampling Using Bailers*
- CDM Federal SOP 1-7 - *Wipe Sampling*
- CDM Federal SOP 1-9 - *Tap Water Sampling*
- CDM Federal SOP 1-11 - *Sediment/Sludge Sampling*
- CDM Federal SOP 2-2 - *Guide to Handling Investigation-Derived Waste*
- CDM Federal SOP 3-1 - *Geoprobe® Sampling*

3.0 Responsibilities

The project manager or designee, generally the field team leader (FTL), ensures that field personnel are trained in the performance of this procedure and that decontamination is conducted in accordance with this SOP and site-specific work plans. The FTL may also be required to collect and document rinsate samples (also known as equipment blanks) to provide quantitative verification that these procedures have been correctly implemented.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific QA plan.

4.0 Required Equipment

- Stiff-bristle scrub brushes
- Plastic buckets and troughs
- Soap
- Nalgene or Teflon sprayers or wash bottles or 2- to 5-gallon, manual-pump sprayer (pump sprayer material must be compatible with the solution used)
- Plastic sheeting, plastic bags, and/or aluminum foil to keep decontaminated equipment clean between uses
- Disposable wipes, rags, or paper towels
- Potable water*
- Analyte-free water
- Organic-free/analyte-free water
- Gloves, safety glasses, and other protective clothing as specified in the site-specific health and safety plan
- *High-pressure pump with soap dispenser or steam-spray unit (for large equipment only)*
- Appropriate decontamination solutions pesticide grade or better and traceable to a source (e.g., 10 percent and/or 1 percent nitric acid [HNO_3], acetone, methanol, isopropanol, hexane)
- Tools for equipment assembly and disassembly (as required)
- 55-gallon drums or tanks for temporary storage of decontamination water (as required)
- Pallets for drums or tanks holding decontamination water (as required)

* *Potable water may be required to be tested for contaminants before use. Check field plan for requirements.*

5.0 Procedures

All reusable equipment (nondedicated) used to collect, handle, or measure samples shall be decontaminated before coming into contact with any sampled media or personnel using the equipment. Decontamination of equipment shall occur either at a central decontamination station or at portable decontamination stations set up at the sampling location, drill site, or monitoring well location. The centrally located decontamination station shall include an appropriately sized bermed and lined area on which equipment decontamination shall occur and shall be equipped with a collection system and storage vessels. In certain circumstances, berming is not required when small quantities of water are being generated and for some short duration field activities (i.e., pre-remedial sampling). Equipment shall be transported to and from the decontamination station in a manner to prevent cross contamination of equipment and/or area. Precautions taken may include enclosing augers in plastic wrap while being transported on a flatbed truck.

The decontamination area shall be constructed so that contaminated water is either collected directly into appropriate containers (5-gallon buckets or steel wash tubs) or within the berms of the decontamination area that then drains into a collection system. Water from the collection system shall be transferred into 55-gallon drums or portable tanks for temporary storage. Typically, decontamination water shall be staged until sampling results or waste characterization results are obtained and evaluated and the proper disposition of the waste is determined (SOP 2-2, *Guide to Handling Investigation-Derived Waste*). The exact procedure for decontamination waste disposal shall be discussed in the work plan. Also, solvent and acid rinse fluids may need to be segregated from other investigation-derived wastes.

All items that shall come into contact with potentially contaminated media shall be decontaminated before use and between sampling and/or drilling locations. If decontaminated items are not immediately used, they shall be covered either with clean plastic or aluminum foil depending on the size of the item. All decontamination procedures for the equipment being used are as follows:

General Guidelines

- Potable, analyte-free, and organic-free/analyte-free water shall be free of all contaminants of concern. Following the field QA sampling procedure described in the work plan, analytical data from the water source may be required.
- Sampling equipment that has come into contact with oil and grease shall be cleaned with methanol or other approved alternative to remove the oily material. This may be followed by a hexane rinse and then another methanol rinse. Regulatory or client requirements regarding solvent use shall be stated in the work plan.
- All solvents and acids shall be pesticide grade or better and traceable to a source. The corresponding lot numbers shall be recorded in the appropriate logbook.

  Note: Solvents and acids are potentially hazardous materials and must be handled, stored, and transported accordingly. Solvents shall never be used in a closed building. See the site-specific health and safety plan and/or the chemical's MSDS for specific information regarding the safe use of the chemical.
- Decontaminated equipment shall be allowed to air dry before being used.
- Documentation of all cleaning and field QA sampling shall be recorded in the appropriate logbook.
- Gloves, boots, safety glasses, and any other personnel protective clothing and equipment shall be used as specified in the site-specific health and safety plan.

5.1 Heavy Equipment Decontamination

Heavy equipment includes drilling rigs, well development rigs, and backhoes. Follow these steps when decontaminating this equipment:

- Establish a bermed decontamination area that is large enough to fully contain the equipment to be cleaned. If available, an existing wash pad or appropriate paved and bermed area may be used; otherwise, use one or more layers of heavy plastic sheeting to cover the ground surface and berms. All decontamination pads shall be upwind of the area under investigation.
- With the rig in place, spray areas (rear of rig or backhoe) exposed to contaminated media using a hot water high-pressure sprayer. Be sure to spray down all surfaces, including the undercarriage.
- Use brushes, soap, and potable water to remove dirt whenever necessary.
- Remove equipment from the decontamination pad and allow it to air dry before returning it to the work site.
- Record the equipment type, date, time, and method of decontamination in the appropriate logbook.

- After decontamination activities are completed, collect all contaminated wastewater, plastic sheeting, and disposable gloves, boots, and clothing in separate containers or receptacles. All receptacles containing contaminated items must be properly labeled for disposal as detailed in the field plan. Liquids and solids must be drummed separately.

5.2 Downhole Equipment Decontamination

Downhole equipment includes hollow-stem augers, drill pipes, rods, stems, etc. Follow these steps when decontaminating this equipment:

- Set up a centralized decontamination area, if possible. This area shall be set up to collect contaminated rinse waters and to minimize the spread of airborne spray.
- Set up a "clean" area upwind of the decontamination area to receive cleaned equipment for air-drying. At a minimum, clean plastic sheeting must be used to cover the ground, tables, or other surfaces on which decontaminated equipment is to be placed. All decontamination pads shall be upwind of any areas under investigation.
- Place the object to be cleaned on aluminum foil or plastic-covered wooden sawhorses or other supports. The objects to be cleaned shall be at least 2 feet above the ground to avoid splashback when decontaminating.
- Using soap and potable water in the hot water high-pressure sprayer (or steam unit), spray the contaminated equipment. Aim downward to avoid spraying outside the decontamination area. Be sure to spray inside corners and gaps especially well. Use a brush, if necessary, to dislodge dirt.
- If using soapy water, rinse the equipment using clean, potable water. If using hot water, the rinse step is not necessary if the hot water does not contain a detergent. If the hot water contains a detergent, this final clean water rinse is required.
- Using a suitable sprayer, rinse the equipment thoroughly with analyte-free water.
- Remove the equipment from the decontamination area and place in a clean area upwind to air dry.
- Record equipment type, date, time, and method of decontamination in the appropriate logbook.
- After decontamination activities are completed, collect all contaminated wastewaters, plastic sheeting, and disposable gloves, boots, and clothing in separate containers or receptacles. All receptacles containing contaminated items must be properly labeled for disposal. Liquids and solids must be drummed separately.

5.3 Sampling Equipment Decontamination

Follow these steps when decontaminating sampling equipment:

- Set up a decontamination line on plastic sheeting. The decontamination line shall progress from "dirty" to "clean." A clean area shall be established upwind of the decontamination wash/rinse activities to dry the equipment. At a minimum, clean plastic sheeting must be used to cover the ground, table, or other surfaces that the decontaminated equipment is placed for drying.
- Disassemble any items that may trap contaminants internally. Do not reassemble the items until decontamination and air drying are complete.
- Wash the items with potable water and soap using a stiff brush as necessary to remove particulate matter and surface films. The items may be steam cleaned using soap and hot water as an alternative to brushing. ***Note*: Polyvinyl chloride or plastic items shall not be steam cleaned.** Items that have come into contact with concentrated and/or oily contaminants may need to be rinsed with a solvent such as hexane and allowed to air dry prior to this washing step.
- Thoroughly rinse the items with potable water.

- If sampling for metals, thoroughly rinse the items with an acid solution (e.g., 10 percent nitric acid) followed by a rinse using analyte-free water. If sampling for organic compounds, thoroughly rinse the items with solvent (e.g., isopropanol) followed by a rinse using analyte-free water. The specific chemicals used for the acid rinse and solvent rinse phases shall be specified in the work plan. The acid rinsate and solvent rinsate must each be containerized separately. Acids and solvents are potentially hazardous materials and care must be exercised when using these chemicals to prevent adverse health affects (e.g., skin burns, irritation to the eyes and respiratory system). Appropriate personal protective equipment must be worn when using these chemicals. These chemicals (including spent rinsate) must be managed and stored appropriately. Special measures such as proper labels, paperwork, notification, etc. may be required when transporting or shipping these chemicals.
- Rinse the items thoroughly using organic-free/analyte-free water.
- Allow the items to air dry completely.
- After drying, reassemble the parts as necessary and wrap the items in clean plastic wrap or in aluminum foil.
- Record equipment type, date, time, and method of decontamination in the appropriate logbook.
- After decontamination activities are completed, collect all contaminated waters, used solvents and acids, plastic sheeting, and disposable personal protective equipment. Place the contaminated items in properly labeled drums for disposal. Liquids and solids must be drummed separately. Refer to site-specific plans for labeling and waste management requirements.

5.4 Pump Decontamination

Follow the manufacturer's recommendation for specified pump decontamination procedures. At a minimum, follow these steps when decontaminating pumps:

- Set up the decontamination area and separate "clean" storage area using plastic sheeting to cover the ground, tables, and other surfaces. Set up four containers: the first container shall contain dilute (nonfoaming) soapy water, the second container shall contain potable water, the third container shall be empty to receive wastewater, and the fourth container shall contain analyte-free water.
- The pump shall be set up in the same configuration as for sampling. Submerge the pump intake (or the pump, if submersible) and all downhole-wetted parts (tubing, piping, foot valve) in the soapy water of the first container. Place the discharge outlet in the wastewater container above the level of the wastewater. Pump soapy water through the pump assembly until it discharges to the waste container. Scrub the outside of the pump and other wetted parts with a metal brush.
- Move the pump assembly to the potable water container while leaving discharge outlet in the waste container. All downhole-wetted parts must be immersed in the potable water rinse. Pump potable water through the pump assembly until it runs clear.
- Move the pump intake to the analyte-free water container. Pump the water through the pump assembly. Pump the volume of water through the pump specified in the field plan. Usually, three pump-and-line-assembly volumes shall be required.
- Decontaminate the discharge outlet by hand, following the steps outlined in Section 5.3.
- Remove the decontaminated pump assembly to the clean area and allow it to air dry upwind of the decontamination area. Intake and outlet orifices shall be covered with aluminum foil to prevent the entry of airborne contaminants and particles.
- Record the equipment type, serial number, date, time, and method of decontamination in the appropriate logbook.

5.5 Instrument Probe Decontamination

Instrument probes used for field measurements such as pH meters, conductivity meters, etc. shall be decontaminated between samples and after use with analyte-free, or better, water.

5.6 Waste Disposal

Refer to site-specific plans and SOP 2-2 for waste disposal requirements. The following are guidelines for disposing of wastes:

- All wash water, rinse water, and decontamination solutions that have come in contact with contaminated equipment are to be handled, packaged, labeled, marked, stored, and disposed of as investigation-derived waste.
- Small quantities of decontamination solutions may be allowed to evaporate to dryness.
- If large quantities of used decontamination solutions shall be generated, each type of waste shall be contained in separate containers.
- Unless otherwise required, plastic sheeting and disposable protective clothing may be treated as solid, nonhazardous waste.
- Waste liquids shall be sampled, analyzed for contaminants of concern in accordance with disposal regulations, and disposed of accordingly.

6.0 Restrictions/Limitations

Nitric acid and polar solvent rinses are necessary only when sampling for metals or organics, respectively. These steps shall not be used, unless required, because of the potential for acid burns and ignitability hazards.

If the field equipment is not thoroughly rinsed and allowed to completely air dry before use, volatile organic residue, which interferes with the analysis, may be detected in the samples. The occurrence of residual organic solvents is often dependent on the time of year sampling is conducted. In the summer, volatilization is rapid, and in the winter, volatilization is slow. Check with your EPA region, state, and client for approved decontamination solvents.

7.0 References

American Society for Testing and Materials. 2002. *Standard Practice for Decontamination of Field Equipment at Nonradioactive Waste Sites*, ASTM D5088-02. January 10.

Department of Energy. Hazardous Waste Remedial Actions Program. 1996. *Standard Operating Procedures for Site Characterization*, DOE/HWP-100/R1. September.

_____. Hazardous Waste Remedial Actions Program. 1996. *Quality Control Requirements for Field Methods*, DOE/HWP-69/R2. September.

U. S. Environmental Protection Agency. 1987. *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.1.

_____. 1992. *Standard Operating Safety Guidelines*; Publication 9285.1-03. June.

_____. Region 2. 1989. *CERCLA Quality Assurance Manual*, Revision 1.

_____. Region 4. 2001. *Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual*. November.

Control of Measurement and Test Equipment

SOP 5-1
Revision: 8
Date: March 2007

Prepared: Dave Johnson

Technical Review: Steve Guthrie

E-Signed by Michael C. Malloy
VERIFY authenticity with ApproveIt

QA Review: Jo Nell Mullins

E-Signed by P. Michael Schwan
VERIFY authenticity with ApproveIt

Approved: *Signature/Date*

Issued: *Signature/Date*

1.0 Objective

The objective of this standard operating procedure (SOP) is to establish the baseline requirements, procedures, and responsibilities inherent to the control and use of all measurement and test equipment (M&TE). Contractual obligations may require more specific or stringent requirements that must also be implemented.

2.0 Background

2.1 Definitions

Traceability - The ability to trace the history, application, or location of an item and like items or activities by means of recorded identification.

2.2 Associated Procedures

- CDM Federal Technical SOP 4-1, *Field Logbook Content and Control*
- CDM Quality Procedures (QPs) 2.1 and 2.3
- Manufacturer's operating and maintenance and calibration procedures

2.3 Discussion

M&TE may be government furnished (GF), rented or leased from an outside vendor, or purchased. It is essential that measurements and tests resulting from the use of this equipment be of the highest accountability and integrity. To facilitate that, the equipment shall be used in full understanding and compliance with the instructions and specifications included in the manufacturer's operations and maintenance and calibration procedures and in accordance with any other related project-specific requirements.

3.0 Responsibilities

All staff with responsibility for the direct control and/or use of M&TE are responsible for being knowledgeable of and understanding and implementing the requirements contained herein as well as any other related project-specific requirements.

The project manager (PM) or designee (equipment coordinator, quality assurance coordinator, field team leader, etc.) is responsible for initiating and tracking the requirements contained herein.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance plan.

4.0 Requirements for M&TE

- Determine and implement M&TE related project-specific requirements
- The maintenance and calibration procedures must be followed when using M&TE
- Obtain the maintenance and calibration procedures if they are missing or incomplete
- Attach or include the maintenance and calibration procedures with the M&TE
- Prepare and record maintenance and calibration in an equipment log or a field log as appropriate (Figure 1)
- Maintain M&TE records
- Label M&TE requiring routine or scheduled calibration (when required)
- Perform maintenance and calibration using the appropriate procedure and calibration standards
- Identify and take action on nonconforming M&TE

5.0 Procedures

5.1 Determine if Other Related Project-Specific Requirements Apply

For all M&TE:
The PM or designee shall determine if M&TE related project-specific requirements apply. If M&TE related project-specific requirements apply, obtain a copy of them and review and implement as appropriate.

5.2 Obtain the Operating and Maintenance and Calibration Documents

For GF M&TE that is to be procured:
Requisitioner - Specify that the maintenance and calibration procedures be included.

For GF M&TE that is acquired as a result of a property transfer:
Receiver - Inspect the M&TE to determine whether maintenance and calibration procedures are included with the item. If missing or incomplete, order the appropriate documentation from the manufacturer.

For M&TE that is to be rented or leased from an outside vendor:
Requisitioner - Specify that the maintenance and calibration procedures, the latest calibration record, and the calibration standards certification be included. If this information is not delivered with the M&TE, ask the procurement division to request it from the vendor.

5.3 Prepare and Record Maintenance and Calibration Records

For all M&TE:
PM or Designee - Record all maintenance and calibration events in a field log unless other project-specific requirements apply.

For GF M&TE only (does not apply to rented or leased M&TE):
If an equipment log is a project specific requirement, perform the following:

Receiver - Notify the PM or designee for the overall property control of the equipment upon receipt of an item of M&TE.

PM or Designee and User:
- Prepare a sequentially page numbered equipment log for the item using the maintenance and calibration form (or equivalent) (Figure 1).
- Record all maintenance and calibration events in an equipment log.

5.4 Label M&TE Requiring Calibration

For GF M&TE only (does not apply to rented or leased M&TE):
If calibration labeling is a project specific requirement, perform the following:

PM or Designee:
- Read the maintenance and calibration procedures to determine the frequency of calibration required.
- If an M&TE item requires calibration before use, affix a label to the item stating "Calibrate Before Use."
- If an M&TE item requires calibration at other scheduled intervals, e.g., monthly, annually, etc., affix a label listing the date of the last calibration, the date the item is next due for a calibration, the initials of the person who performed the calibration, and a space for the initials of the person who shall perform the next calibration.

5.5 Operating, Maintaining or Calibrating an M&TE Item

For all M&TE:
PM or Designee and User - Operate, maintain, and calibrate M&TE in accordance with the maintenance and calibration procedures. Record maintenance and calibration actions in the equipment log or field log.

5.6 Shipment

For GF M&TE:
Shipper - Inspect the item to ensure that the maintenance and calibration procedures are attached to the shipping case, or included, and that a copy of the most recent equipment log entry page (if required) is included with the shipment. If the maintenance and calibration procedures and/or the current equipment log page (if required) is missing or incomplete, do not ship the item. Immediately contact the PM or designee and request a replacement.

For M&TE that is rented or leased from an outside vendor:
Shipper - Inspect the item to ensure that the maintenance and calibration procedures and latest calibration and standards certification records are included prior to shipment. If any documentation is missing or incomplete, do not ship the item. Immediately contact the procurement division and request that they obtain the documentation from the vendor.

5.7 Records Maintenance

For GF M&TE:
PM or Designee - Create a file upon the initial receipt of an item of M&TE or calibration standard. Organize the files by contract origin and by M&TE item and calibration standard. Store all files in a cabinet, file drawer, or other appropriate storage media at the pertinent warehouse or office location.

Receiver - Forward the original packing slip to the procurement division and a photocopy to the PM or designee.

PM or Designee and User:
- Maintain all original documents in the equipment file except for the packing slip and field log.
- File the photocopy of the packing slip in the M&TE file.
- Record all maintenance and calibration in an equipment log or field log (as appropriate). File the completed equipment logs in the M&TE records. Forward completed field logs to the PM for inclusion in the project files.

For M&TE rented or leased from an outside vendor:
Receiver - Forward the packing slip to the procurement division.

User:
- Forward the completed field log to the PM for inclusion in the project files.
- Retain the most current maintenance and calibration record and calibration standards certifications with the M&TE item and forward previous versions to the PM for inclusion in the project files.

5.8 Traceability of Calibration Standards

For all items of M&TE:
PM or Designee and User:
- When ordering calibration standards, request nationally recognized standards as specified or required. Request commercially available standards when not otherwise specified or required. Or, request standards in accordance with other related project-specific requirements.
- Require certifications for standards that clearly state the traceability.
- Require Material Safety Data Sheets to be provided with standards.
- Note standards that are perishable and consume or dispose of them on or before the expiration date.

5.9 M&TE That Fails Calibration

For any M&TE item that cannot be calibrated or adjusted to perform accurately:
PM or Designee
- Immediately discontinue use and segregate the item from other equipment. Notify the appropriate PM and take appropriate action in accordance with the CDM QP 2.3 for nonconforming items.
- Review the current and previous maintenance and calibration records to determine if the validity of current or previous measurement and test results could have been affected and notify the appropriate PM(s) of the results of the review.

6.0 Restrictions/Limitations

On an item-by-item basis, exemptions from the requirements of this SOP may be granted by the Headquarters health and safety manager and/or Headquarters quality assurance director. All exemptions shall be documented by the grantor and included in the equipment records as appropriate.

7.0 References

CDM Federal Programs Corporation. 2007. *Quality Assurance Manual.* Rev. 11.

CDM Federal Programs Corporation. 2005. *Government Property Manual.* Rev. 3.

Figure 1

CDM
A subsidiary of Camp Dresser & McKee Inc.

Maintenance and Calibration

Date: Time: (a.m./p.m.)

Employee Name: Equipment Description:

Contract/Project: Equipment ID No.:

Activity: Equipment Serial No.:

Maintenance

Maintenance Performed:

Comments:

Signature: Date:

Calibration/Field Check

Calibration Standard: Concentration of Standard:

Lot No. of Calibration Standard: Expiration Date of Calibration Standard:

Pre-Calibration Reading: Post-Calibration Reading:

Additional Readings: Additional Readings:

Additional Readings: Additional Readings:

Pre-Field Check Reading: Post-Field Check Reading:

Adjustment(s):

Calibration: ☐ Passed ☐ Failed

Comments:

Signature: Date:

Project-Specific Guidance
Completion of Field Sample Data Sheets (FSDSs)

Project: Libby Asbestos Project

Quality Assurance Project Plan (QAPP): All Quality Assurance Project Plans governing sample collection (all media)

Document No.: CDM-LIBBY-03 Revision 3

Prepared by: Terry Crowell Date: 4/12/06

Approved by: Documented via Modification Form #LFO-000093; approved by P. Carnes (Volpe) on 4/13/06 and M. Goldade (EPA) on 12/5/06

A field sample data sheet (FSDS) must be completed using the following guidance.

Definitions:
eLASTIC – Electronic Libby Asbestos Sample Tracking Information Center. The onsite Libby property and sample tracking database maintained by CDM.

Office Administrator – Person responsible for preparing labels and blanks FSDSs, and assigning them to field personnel

Owner – Person who owns a property (may or may not be the current occupant)

Sample Coordinator – Person to whom samples and FSDSs are relinquished; responsible for preparing COCs and submitting samples to the laboratory

NA – not applicable

MET station – meteorological (i.e., weather) data station

Field Sample Data Sheets - All Media

Sheet No.: Pre-assigned unique, sequential sheet number assigned by an office administrator.

Field Logbook No.: Number of the logbook being used to record information specific to the samples on the FSDS.

Page No.: Page number in the logbook being used to record information specific to the samples on the FSDS.

Sampling Date: *Date samples are collected in the form* MM/DD/YY.

Address: Address of the property being sampled as it appears in eLASTIC (if the property has been investigated previously). Addresses are to be recorded in the following format: Street number – Direction – Street Name – Street Abbreviation, where:

Street number = the number of the house or commercial building
Direction = the abbreviation of the street direction, when applicable. Periods are to be used after the street direction abbreviation (e.g., N., W.). *Exclusions to this rule in Libby are: Highway 37 N; Highway 2 W; and Highway 2 S.*
Street name = correct spelling of the street name
Street abbreviation = Rd, Ave, etc., when applicable. Periods are NOT to be used following these abbreviations.

Examples:

Road – Rd
Avenue – Ave
Extension - Ext
Street – St
Circle – Cr
Boulevard – Blvd

Examples:

510 N Mineral Ave
607 E Cedar St Ext
521 Pipe Creek Rd
2800 Highway 37 N
300 Highway 2 S

Owner: Name of the property owner (not necessarily the current occupant) as it appears in eLASTIC.

Business Name: If a business is located on the property, record the name as it appears in eLASTIC. If a business is not located on the property, record NA.

Land Use: Description of land use on which property is located.

Sampling Team: Company affiliation of sampling team.

Names: Full name of all members of the sampling team.

Index ID: Sample identification (ID) number in the format XX-#####, where:

XX = a 2-digit set of alpha-numeric digits indicating the sampling and analysis plan or quality assurance project plan the sample is collected under
= a 5-digit unique, sequential number

Pre-printed Index ID labels are assigned to each sampling team by an office administrator.

Examples: CS-00100
1D-04668
SQ-00225

Location ID: Unique ID number assigned to each sample location requiring a unique global positioning system (GPS) coordinate. Pre-printed Location ID labels are assigned to each sampling team by an office administrator.

For samples requiring GPS coordinates, location IDs are in the form SP-######, where SP indicates 'sample point'.

For samples collected inside a building, location IDs are in the form BD-######, where BD indicates 'building'.

For samples collected on a property that are stationary (e.g., personal air samples collected outside during excavation work), location IDs are in the form AD-######, where AD indicates 'address' (or work area).

Note that in the case of lot blanks, AD-000001 is used for the location ID. In the case of field blanks, the AD number of the property where the cassette is opened is used for outdoor sampling or the BD number of the building if sampling occurs inside. In the case of exposure monitoring, or any other task where sampling is conducted at multiple properties, MA-000001 is used and the appropriate addresses are listed in the comment section.

Location IDs are tracked in eLASTIC, which should be used for reference whenever possible.

Sample Group: The sample group for response action samples must be one of the following options:

- Alley
- Attic
- Barn
- Basement
- Blank
- Borrow source
- Building
- Carport
- Crawl space
- Cumulative risk assessment
- Driveway
- Exposure monitoring
- Field
- Flower pots
- Flowerbed
- Former flowerbed
- Former garden
- Garage
- Garden
- Greenhouse
- House
- Lab
- Lean-to
- Mine
- Non-specific use area
- Park
- Parking lot
- Play area
- Property
- Pumphouse
- Road
- Root cellar
- Shed
- Specific-use Area
- Stockpile
- Vehicle
- Walkway
- Yard

Location Description: Description of the location where a sample was collected. Examples are: back yard, side yard, driveway, etc. for soil samples; and basement, ground floor, second floor, etc. for air or dust samples. If a soil sample is composed of sub-samples collected from more than one location, circle all that apply.

Category: FS = field sample; FD = field duplicate; FB = field blank; LB = lot blank; EB = Equipment Blank; Trip Blank; SS = Sample Split, or Other. Circle the applicable response. If the sample is a duplicate or split, indicate the ID of the parent field sample.

Field Comments: Any additional information specific to a sample, including issues that may affect data quality (e.g., potential overloading for air or dust samples).

QC (Field Team): Initials of field team member that completes the quality control check of FSDS.

Entered (LFO): Initials of sample coordination team member that enters the applicable FSDS information into eLASTIC.

Entered: Completed by Volpe personnel at time of data entry into Libby v2.

Validated: Completed by Volpe personnel at time of the data entry check.

The following sections provide instructions for recording media-specific information.

Field Sample Data Sheet - Soil

Matrix Type: Soil samples will typically be surface samples – circle this response if appropriate. If the sample is not a surface sample, complete the "other" line using an applicable descriptor (e.g., mining waste, subsurface soil, fill, etc.).

GPS Status: Indicate if the GPS point was Collected, Not Collected – no signal (3 attempts) or Not Collected – not required.

GPS File: Indicate the file name for points required to be collected, or NA for points not required.

Type: Indicate the type of sample collected (grab or composite). If the sample is a composite sample, indicate the number of sub-samples collected.

Sample Time: The time of sample collection in military time.

Top Depth: Top depth of sample in inches below ground surface.

Bottom Depth: Bottom depth of sample in inches below ground surface.

Field Comments: For soil, as requested on the FSDS, indicate the presence/absence of visible vermiculite and the BD number of the main building associated with the property (does not apply to undeveloped lots or parcels).

Field Sample Data Sheet – Stationary Air

Matrix Type: Circle whether the air sample was collected indoors, outdoors, or NA (e.g., lot blanks).

Filter Diameter: Circle the applicable filter diameter. For all standard project air sampling, cassettes with a 25-millimeter filter diameter will be used.

Pore Size: Circle the applicable pore size. For standard project air sampling, phase contrast microscopy (PCM) cassettes with a 0.8-micron pore size filter will be used.

GPS Status: Indicate if the GPS point was Collected, Not Collected – no signal (3 attempts) or Not Collected – not required.

GPS File: Indicate the file name for points required to be collected, or NA for points not required.

Flow Meter Type: Circle the applicable flow meter used.

Pump ID Number: Record the identification number of the pump used to collect the air sample.

Flow Meter ID Number: Record the identification number of the flow meter used to collect the air sample.

Start Date: Record the start date in the format DD-MM-YY.

Start Time: Record the starting time of each air sample aliquot in military time.

Start Flow: Record the starting pump flow rate for the air sample colleted in liters per minute (L/min).

Stop Date: Record the stop date in the format DD-MM-YY.

Stop Time: Record the stopping time of each air sample aliquot in military time.

Stop Flow: Record the stopping pump flow rate for the air sample colleted in liters per minute (L/min).

Pump Fault: Indicate if the pump faulted during air sample collection, as indicated by a greater than 10% difference in flow rate or a mechanical fault (pump shut-off).

MET Station onsite: Indicate whether a MET station was operating onsite during sampling. For lot blanks, circle NA.

Sample Type: Circle the appropriate response as they relate to removal work conducted. That is, if samples were collected prior to ANY removal work, circle 'Pre'. If samples are collected following ALL removal work (i.e., post-clean up evaluation), circle 'Post'. If samples are clearance, indicate whether first, second, etc. clearance is attempting to be achieved.

Cassette Lot Number: For lot blanks, indicate the cassette lot number.

Field Sample Data Sheet – Personal Air

Person Sampled: First and last name of worker being monitored.

SSN: The last 4 digits of the Social Security Number of the worker being monitored.

Task: A brief description of the task being performed by the worker being monitored. Some examples are: vermiculite-containing insulation (VCI) removal, laborer, detail cleaning.

Matrix Type: Circle whether the air sample was collected indoors, outdoors, both indoor and outdoor (e.g., exposure monitoring).

Filter Diameter: Circle the applicable filter diameter. For all standard project air sampling, cassettes with a 25-millimeter filter diameter will be used.

Pore Size: Circle the applicable pore size. For standard project air sampling, phase contrast microscopy (PCM) cassettes with a 0.8-micron pore size filter will be used.

GPS Status: Indicate if the GPS point was Collected, Not Collected – no signal (3 attempts) or Not Collected – not required.

GPS File: Indicate the file name for points required to be collected, or NA for points not required.

Flow Meter Type: Circle the applicable flow meter used.

Pump ID Number: Record the identification number of the pump used to collect the air sample.

Flow Meter ID Number: Record the identification number of the flow meter used to collect the air sample.

Start Date: Record the start date in the format DD-MM-YY.

Start Time: Record the starting time of each air sample aliquot in military time.

Start Flow: Record the starting pump flow rate for the air sample colleted in liters per minute (L/min).

Stop Date: Record the stop date in the format DD-MM-YY.

Stop Time: Record the stopping time of each air sample aliquot in military time.

Stop Flow: Record the stopping pump flow rate for the air sample colleted in liters per minute (L/min).

Pump Fault: Indicate if the pump faulted during air sample collection, as indicated by a greater than 10% difference in flow rate or a mechanical fault (pump shut-off).

MET Station onsite: Indicate whether a MET station was operating onsite during sampling. For lot blanks, circle NA.

Sample Type: Circle the applicable response. For the response action personal air sampling, select one of the following:

TWA – time-weighted average sample, collected over an 8-hour period or used in conjunction with one or more other personal air samples to constitute monitoring over an average work day
EXC – excursion sample, collected over a 30-minute period (time may be approximate)
NA – used for all blanks

Cassette Lot Number: For lot blanks, indicate the cassette lot number.

Field Sample Data Sheet – Dust

Matrix Type: Indicate the type of surface the sample was collected from.

Sample Area: Circle the total area sampled with the cassette. Standard project protocol is 300 cm2, unless loading is an issue.

Filter Diameter: Circle the applicable filter diameter. For standard project dust sampling, cassettes with a 25-millimeter filter diameter will be used.

Pore Size: Circle the applicable pore size. For standard project dust sampling, transmission electron microscopy (TEM) cassettes with a 0.45-micron pore size filter will be used.

Flow Meter Type: Circle the type of flow meter used to calibrate the pump flow rate.

Flow Meter ID No.: Record the identification number of the flow meter used to calibrate the pump flow rate.

Pump ID No.: Record the identification number of the pump used to collect the sample.

Start Time: Record the starting time of each sample aliquot collection in military time.

Start Flow: Record the starting pump flow rate for the sample colleted in liters per minute (L/min).

Stop Time: Record the stopping time of each sample aliquot collection in military time.

Stop Flow: Record the stopping pump flow rate for the sample colleted in liters per minute (L/min).

Pump Fault: Indicate if the pump faulted during dust sample collection, as indicated by a greater than 10% difference in flow rate or a mechanical fault (pump shut-off).

Field Comments: For dust, as requested on the FSDS, indicate the specific subsample locations.

Field Sample Data Sheet – Water and Sediment

Matrix Type: Circle the appropriate type of water.

Sample Time: The time of sample collection in military time.

GPS Status: Indicate if the GPS point was Collected, Not Collected – no signal (3 attempts) or Not Collected – not required.

GPS File: Indicate the file name for points required to be collected, or NA for points not required.

Field Sample Data Sheet – Bulk Materials

Matrix Type: Circle insulation or fill in the type of material (e.g., chinking, stucco, etc.) as applicable.

Sample Time: The time of sample collection in military time.

Field Sample Data Sheet – Dustfall

Matrix Type: Circle whether the dustfall sample was collected indoors, outdoors, other, or NA (e.g., lot blanks).

GPS Status: Indicate if the GPS point was Collected, Not Collected – no signal (3 attempts) or Not Collected – not required.

GPS File: Indicate the file name for points required to be collected, or NA for points not required.

Wind Meter (MET) Station ID no.: Enter the meter number for the MET station located onsite.

Start Date: Record the start date in the format DD-MM-YY.

Start Time: Record the starting time of sample collection in military time.

Stop Date: Record the stop date in the format DD-MM-YY.

Stop Time: Record the stopping time of sample collection in military time.

Project-Specific Standard Operating Procedure
Libby Asbestos Project

SOP No.: CDM-LIBBY-09, Revision 0
SOP Title: Global Positioning Satellite (GPS) Coordinate Collection and Handling
Project: Libby Asbestos Project
Project No.: 2616
Client: U.S. Department of Transportation (DOT)/Volpe Center

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CDM Quality Assurance Reviewer

1.0 Objective

The objective of this standard operating procedure (SOP) is to provide a standardized approach for the collection and handling of GPS data at the Libby Asbestos Site (Site).

2.0 Background

2.1 Definitions

Libby_Sampling Data Dictionary - All Trimble handheld units used at the Site are pre-programmed with the Libby _Sampling data dictionary, specific to the spatial data collection needs for the Libby Asbestos Project. All personnel required to collect GPS data will be familiar with the contents of the Libby_Sampling data dictionary, which contains the following features: Soil Sample, Air Sample, Dustfall (Settled Dust) Sample, Water/Sediment Sample, Building Location, Interest Point, Sample Area, and Interest Area. The Trimble units also are loaded with a generic data dictionary that handles collection of generic lines, points and areas.

2.2 Discussion

The following attributes are required to be collected as indicated in Table 1 for each feature type when a GPS coordinate is collected:

Table 1 – Attributes Collected in the Libby_Sampling Data Dictionary

Feature Name	Attributes Collected
Building Location	LocationID, Address, Comments
Soil Sample	LocationID, IndexID, Sample_Type, SamplGroup, Upper_Depth, Lower_Depth, Comment
Air and Dustfall Samples	LocationID, IndexID, Sample_ Type, SamplGroup , Comment
Water/Sediment Sample	LocationID, IndexID, Matrix_Type, Comment
Interest Point	Location, Land_Use, Comment
Interest Area	Location, Land_Use, Comment
Sample Area	LocationID, IndexID, Num_of _Composites, Upper_Depth, Lower_Depth, Comment

These attributes are discussed in detail in Section 4 of this document.

3.0 Responsibilities

GPS data is collected by investigation, pre-design, and removal oversight staff as specified in the sampling and analysis plans specific to those programs. Transfer of GPS data from the field

equipment to the onsite server, as well as initial data review, processing, and transmittal of data off-site will be performed by a designated on-site IMS staff member during peak field season (April through November), and by administrative support staff during the off season. These additional procedures are documented separately and are posted on CDM's e-room at: https://team.cdm.com/eRoom/R8-RAC/Libby/0_290a.

4.0 Procedures

The following sections describe how GPS points are collected and handled for features commonly used at the Site.

4.1 GPS Point Collection

Building Locations

For building locations, a GPS point is collected near the front door or main entrance of the building. Location IDs beginning with the prefix "BD" (indicating a building point), are used for such locations.

Soil Samples

For **Grab** samples, a GPS point is collected directly above the location where each sample is collected. Location IDs beginning with the prefix "SP" (indicating a sample point), are used for such locations.

For **Composite** samples, a GPS point is collected at the approximate center of each sample area. In the case of an irregular-shaped sample area or sample area that is non-continuous (e.g., a flowerbed that wraps around a house), a GPS point is collected at the center of the largest continuous sample area. Location IDs beginning with the prefix "SP" are used for such locations.

Outdoor Stationary Air and Dustfall (Settled Dust) Samples

For permanent (i.e., samples represent a consistent monitoring zone or area and are collected on a routine schedule) outdoor stationary air and dustfall sample locations, a GPS point is collected at each unique sample location. All subsequent samples taken at that location will be assigned the same Location ID and X,Y coordinates. The GPS point is only collected once. Location IDs beginning with the prefix "SP" (indicating a sample point), are used for such locations.

GPS points are **not** collected for the following features:

- Stationary air, dust, and soil samples collected inside or beneath structures (locations are associated with the X,Y coordinate of the building where the sample was collected)
- Stationary air samples, with the exception of permanent monitoring locations as designated in site-specific removal work plans or Response Action Work Plan Addenda
- Duplicate or Replicate air or dust samples (assigned the same location ID as the parent sample)
- Soil samples taken at depth from the same X,Y location as a previously collected sample. The at-depth soil sample will be assigned the same Location ID as the shallower sample in order to relate both samples to the same X,Y coordinate.
- Duplicate or split soil samples (assigned the same location ID as the parent sample)
- Personal air samples (locations are associated with the X,Y coordinate of the building or property where the sample was collected)

Interest Point, Interest Area, Sample Area
GPS points for these features are not routinely collected on the Libby Asbestos Project. However, they are included in the Libby_Sampling data dictionary in the event that a GPS point is collected for an area where no sampling is involved, or a series of points is collected to document the perimeter of an interest area or sample area.

4.2 Operation of Trimble Pro XRS and GeoXT Handheld Units:

Operators must be standing at the sample location *before* the unit starts to collect positions. Once the unit has started collecting positions, the operator must remain standing at the sample location until the minimum required positions have been collected. A minimum of **30** positions will be collected for each GPS location. More positions will be required in circumstances where the position dilution of precision (PDOP) is greater than the default setting of 4.5. Plan GPS collection around satellite availability & times when PDOP is < 4.5.

Record-keeping Requirements:

Serial numbers of the Trimble datalogger, receiver, and antenna will be recorded in a field logbook. GPS filenames will be recorded in the logbook and on field sample data sheets (FSDSs).

Data Collection Instructions for Trimble Pro XRS:

Turn on the unit and select *Data Collection* from the main menu. You will be prompted to create a new file, open an existing file, or create a base file. Choose *create new file* and press Enter. There will be a generic default file name that begins with "*RO...*" followed by the date. Create a new file name using the following naming convention: **T1A10204**, where **T1** refers to the specific Trimble unit you are using, **A** refers to the first file of the day (**B** would be the second file of the day, and so on), and **10204** refers to October 20, 2004. You are limited to only 8 characters so the date notation will be MMDDY. The setting for data dictionary should always be set to Libby_Sampling. Press Enter to bring up the Start Feature menu.

From the Start Feature menu you will select the type of location data that you want to collect. Press the F1 key to pause the unit until you are ready to start collecting data. Highlight the appropriate data type and press Enter. (Note, if you do not have the unit paused it will start collecting data as soon as you press Enter.) Using the alphanumeric keypad and the directional keypad enter the *Index* and *Location ID* exactly as they appear on the printed labels. Under the *Sample Type* field you will see an arrow indicating a drop-down menu with preset options. If you scroll to the right while *Sample Type* is highlighted you will see the available options. Select the option you want and then scroll to the right again to exit the drop down menu.

Enter any additional information such as Owner, Sample Grid, Sample Location, etc. in the *Comments* field. Press the F1 key to *resume* collecting positions. The unit will beep for every position it collects displaying the total positions in the lower right corner. After the counter has reached the desired number of positions (30 positions), press Enter and then F1 to confirm and save your data point. Repeat this process for every new location.

Review all entries and correct any mistakes before downloading. You can view and edit the data you have collected by pressing F2 (*Review*) from the Start Feature menu. Use the directional pad to scroll through the locations and press Enter to view the sample information.

If changes are made to the data, be sure to press Enter to save the changes, otherwise just press Esc. Press F2 (*New*) to return to the Start Feature menu.

Additional useful handheld features:

- **Review feature** - allows you to quickly view keyed data for errors, making changes as necessary.
- **Repeat feature** - saves time & reduces keystroke errors when collecting multiple samples of the same type.
- **Offset** - reduces the headache and extra time associated with trying to capture GPS data under bridges, large trees, porches, facades and awnings, or while standing close to a building or other object that can deflect satellites signals from the GPS receiver.
- **Delete Feature** - allows you to delete a feature from a file if, for example, no positions were collected or the sample is voided. This will save time & confusion during the QC process.
- **Rename File** - will allow you to browse through the file names you have created, and quickly edit them if necessary. This will save time if it is done *before* the files are downloaded.
- **Delete File** - will allow you to delete a file from the handheld when necessary. This will save time during the QC process if it is done *before* the files are downloaded.

Data Collection Instructions for Trimble GeoXT:

Turn on the unit and with the stylus, select *GPS* from the lower right menu. This will open the Terra Sync software. Wait for the GPS status screen to recognize at least 4 satellites. Depending on your location, this can take several minutes. If you do not wait long enough, you will you not succeed in collecting your data. The connected satellite names will appear on the left side of the screen - they will be highlighted to indicate that they are connected. Select *Data* from the drop down menus at upper left. There will be a generic default file name that begins with "*RO...*" followed by the date. Create a new file name using the following naming convention: **T1A10204**, where **T1** refers to the specific Trimble unit you are using, **A** refers to the first file of the day (**B** would be the second file of the day, and so on), and **10204** refers to October 20, 2004. You are limited to only 8 characters so the date notation will be MMDDY. The setting for data dictionary should always be set to Libby_Sampling. Select *Create*. Confirm the antennae height by selecting *ok*. Highlight the appropriate feature name and select *Create*. The unit will begin logging the point automatically. Enter the attribute data using the stylus and the keyboard icon located at the bottom of the touch screen. When you are finished recording, hit *ok*, which saves the file and location information. If you have other points to collect within the same file, select the *Options* menu then select *Repeat*.

4.3 GPS Data Transfer

GPS File Transfer to Libbysvr02 from Trimble Pro XRS

- Turn on the Trimble Unit
- *The unit will try to connect to the GPS receiver* - press the **Esc** button
- Select **File Manager**
- Select **File Transfer** - *currently the data consists of .ssf files and is transferred to Libbysvr02\Pfdata\Libby - the file is named with an 8character identifier: T+TrimbleUnitNo+ file number(A for first file collected that day)+mmddy*
- Open Pathfinder Office

- Select **Utilities**
- Select **Data Transfer**
- Select **Add**
- Select **Datafile** – *Pathfinder will search for a connection to the Trimble Unit*
- Connect the cable from the computer to the Trimble Unit
- A list of files will appear when the connection is complete
- Select **Open**
- Select **Transfer All**
- When the download is complete, close the data transfer window – *if downloading files from several units, close and reopen this window between downloads*
- Delete files from the Trimble Unit – *all of the files will be listed - double check that all the files were transferred to libbysvr02 before deleting*

GPS File Transfer to Libbysvr02 from Trimble Pro GeoXT

The Trimble GeoXT connects to a PC through the charger unit using a USB cable *(type A to type B)*, and Microsoft Active Sync software. *(There are Active Sync connection settings to enable or disable once the device is connected to the PC. From the Active Sync menu, select Tools, select Options. These connect the Trimble to other Windows applications on the PC eg; email, task managers, etc. The main reason to disable these settings at Libby, is that the Trimble Units are shared and it does not make sense to activate them.)*

- Turn on the Trimble Unit
- Select **GPS** - from lower right corner *(This opens up the TerraSync GPS software.)*
- Select **Setup**
- Select **Options**
- Select **Disconnect from GPS**
- Select **Data**
- At the bottom of list, select **File Manager**
- Open Pathfinder
- Select **Utilities**
- Select **Data Transfer**
- From the Device list, select **GIS Datalogger on Windows CE**
- Click on the connect icon (the button with the checkmark circled in green). *A picture on the right will indicate the connection status.*

4.4 Preliminary On-site Data Quality Control

Following the download of files from the Trimble units, a copy of each file is made and filed in *Libbysvr02\Pfdata\Libby\RawFiles*. The raw files are not modified but kept as the only copy of the complete set of original downloaded data files. Using the Pathfinder export utility, shapefiles (.shp) of the non-quality control checked (QC'd) files located in *Libbysvr02\Pfdata\Libby* are exported. These shapefiles are opened in ArcMap. A new export file of the attribute tables from Arcmap is created and saved as a .dbf file, then opened and saved in Excel workbook format. The Excel file is imported as a new table into a recent copy of the Electronic Libby Asbestos Sample Tracking Information Center (eLASTIC). A report is generated linking the index_id of the imported table with the index_id of the eLASTIC sample

table. This report is saved in Excel. An Excel comparison function is used to compare location ids from the GPS files with the eLASTIC Location IDs. Any discrepancies are researched to determine if the error resides on the FSDS, was a data entry error in eLASTIC, or a data entry error in the GPS .ssf file. Errors in the .ssf files are corrected using Pathfinder Office. Files used for this data review process (.shp, .dbf files and .xls files) are not retained. The QC'd .ssf files are then emailed in a .zip file from the Libby Office to off-site GIS staff for processing. The QC'd and .zip files are moved to *Libbysvr02\Pfdata\Libby\QC and sent zip files.*

For reference on using Pathfinder export and ARCMap attribute tables see Eroom: Libby GIS folder: GPS to GIS procedure posted by Mike Schultz on August 29, 2006.

4.5 Equipment, Software & Configuration

For Trimble Pro XRS or Trimble GeoXT:

Software used for data transfer: GPS Pathfinder Office 2.90 and 3.10
TerraSync

Software used for on-site QC: GPS Pathfinder Office 2.90 and 3.10
ArcGIS ArcMap
Microsoft Excel
eLASTIC

Configuration Settings (TSC1 5.27 software)
Software can vary with rental equipment. Some settings can be changed to accommodate data collection needs.

Table - 2 Configuration Settings for Trimble Pro XRS		
GPS Rover Options - Logging Options		
Logging Intervals	Point feature	1 s
	Line / area	3 s
	Not in feature	none
	Velocity	none
Confirm end feature	no	
Minimum Positions	30	
Carrier phase	Carrier mode	off
	Minimum time	10mins
GPS Rover Options – Position Filters		
Position mode	Manual 3D	
Elevation mask	15 degrees	
SNR mask	6.0	
DOP type	PDOP	
PDOP mask	6.0	
PDOP switch	4.0	
GPS Rover Options – Real-time input		
Preferred correction source	use uncorrected GPS	
GPS Rover Options – General real-time settings		
Correction age limit	10s	
GPS Rover Options – Antenna options		
Height	6.000USft	

Measure	Vertical	
Confirm	Never	
Type	Integrated GPS/ Beacon/Sat	
Part number	33580-50	
GPS Rover Options – Initial Position		
North	USft	
East	USft	
GPS Rover Options – 2D altitude		
Altitude(MSL)	USft	
Computed at	time	
Computed at	date	
GPS Base Station Options – Logging Options		
Logging Intervals	Measurements	5s
	Positions	30s
Audible Click	Yes	
Log DOP data	Yes	
GPS Base Station Options – Position Filters		
Position mode	Manual 3D	
Elevation mask	15 degrees	
SNR mask	4.0	
PDOP mask	6.0	
PDOP switch	4.0	
GPS Base Station Options – Real-time output options		
Real-time output mode	off	
Radio type	Custom	
Baud rate	9600	
Data bits	8	
Stop bits	1	
Parity	Odd	
RTCM options	Station	1
	Message type	Type 1
	Message interval	5s
	Message suffix	None
	CTS flow control	Off
	CTS xmit delay	0ms
	RTS mode	High
	RTS edge delay	0ms
GPS Base Station Options – Reference position		
Datum	NAD 1983 (Conus)	
Zone	11 North	
NMEA/TSIP Output options		
Output	TSIP	
Baud rate	38400	
Coordinate System	UTM	
Map display options	All show with no background	
Units and Display		
Units	Distance(2D)	US Survey Ft
	Area	Square feet
	Velocity	Miles/Hour
	Angle format	DDMMSSss
	Order	North/East
	North reference	True
	Magnetic declination	Auto

	Null string	
	Language	English
Time and Date	24 hour clock	Yes
	Time	##:##:##
	Date format	MM/DD/YYYY
	Date	MM/DD/YY weekday
Quickmarks	*Attributes*	Repeat
	Confirm	No
Hardware(TSC1) software version 5.27		

Table - 3 Libby Sampling Data Dictionary
"Libby Sampling", Dictionary
"Soil Sample", point, "", 1, seconds, 1, Code
"LocationID", text, 30, required, "SP-000001", required, SP-
"IndexID", text, 30, required, required, Label1
"Sample_Type", menu, required, required, Label2
"COMPOSITE", default
"GRAB"
"SamplGroup", menu, required, required
"BARN"
"BARROW SOURCE"
"BASEMENT"
"BLANK"
"DRIVEWAY"
"FIELD"
"FLOWER BED"
"GARAGE"
"GARDEN"
"HOUSE"
"PARK"
"PROPERTY"
"ROAD"
"SCHOOL"
"SHED"
"WALKWAY"
"YARD", default
"STOCKPILE"
"Upper_Depth", text, 30, required, "Inches", required
"Lower_Depth", text, 30, required, "Inches", required
"Comment", text, 30, normal, normal
"Air Sample", point, "", 1, seconds, 1, Code
"LocationID", text, 30, required, required
"IndexID", text, 30, required, required, Label1
"Sample_Type", menu, required, required, Label2
"PERSONAL"
"STATIONARY", default
"SamplGroup", menu, required, required
"BARN"
"BARROW SOURCE"
"BASEMENT"
"BLANK"
"DRIVEWAY"
"FIELD"

"FLOWER BED"
"GARAGE"
"GARDEN"
"HOUSE", default
"PARK"
"PROPERTY"
"ROAD"
"SCHOOL"
"SHED"
"WALKWAY"
"YARD"
"Comment", text, 30, normal, normal
"Dustfall Sample", point, "", 1, seconds, 1, Code
"LocationID", text, 30, required, required, Label1
"IndexID", text, 30, required, required, Label2
"Sample_Type", menu, required, required
"BUILDING", default
"VEHICLE"
"NA"
"OTHER"
"SamplGroup", menu, required, required
"BARN"
"BARROW SOURCE"
"BASEMENT"
"BLANK"
"DRIVEWAY"
"FIELD"
"FLOWER BED"
"GARAGE"
"GARDEN"
"HOUSE", default
"PARK"
"PROPERTY"
"ROAD"
"SCHOOL"
"SHED"
"WALKWAY"
"YARD"
"STOCKPILE"
"Comment", text, 30, normal, normal
"Building Location", point, "", 1, seconds, 1, Code
"LocationID", text, 30, required, "BD-000001", required, BD-, Label1
"Address", text, 50, required, normal, Label2
"Comments", text, 30, normal, normal
"Water_Sedmnt Sample", point, "", 1, seconds, 1, Code
"LocationID", text, 30, required, required, Label1
"IndexID", text, 30, required, required, Label2
"Matrix_Type", menu, required, required
"Surface"
"Well", default
"Comment", text, 30, normal, normal

"Interest Point", point, "", 1, seconds, 1, Code
"Location", text, 30, required, required, Label1
"Land_Use", text, 30, required, required, Label2
"Comment", text, 30, normal, normal
"Interest Area", area, "", 3, seconds, Code
"Location", text, 30, required, required, Label1
"Land_Use", text, 30, required, required, Label2
"Comment", text, 30, normal, normal
"Sample Area", area, "For odd composits", 3, seconds, Code
"LocationID", text, 30, required, "SP-000001", required
"IndexID", text, 30, required, required, Label1
"Num_of_Composits", numeric, 0, 0, 100, 5, required, "Number of Composits", required, Label2
"Upper_Depth", text, 30, required, "Inches", required
"Lower_Depth", text, 30, required, "Inches", required
"Comment", text, 30, normal, normal

eLASTIC 4.0.1 Standard Operating Procedure

CDM~LIBBY~11, Revision 4.0.1

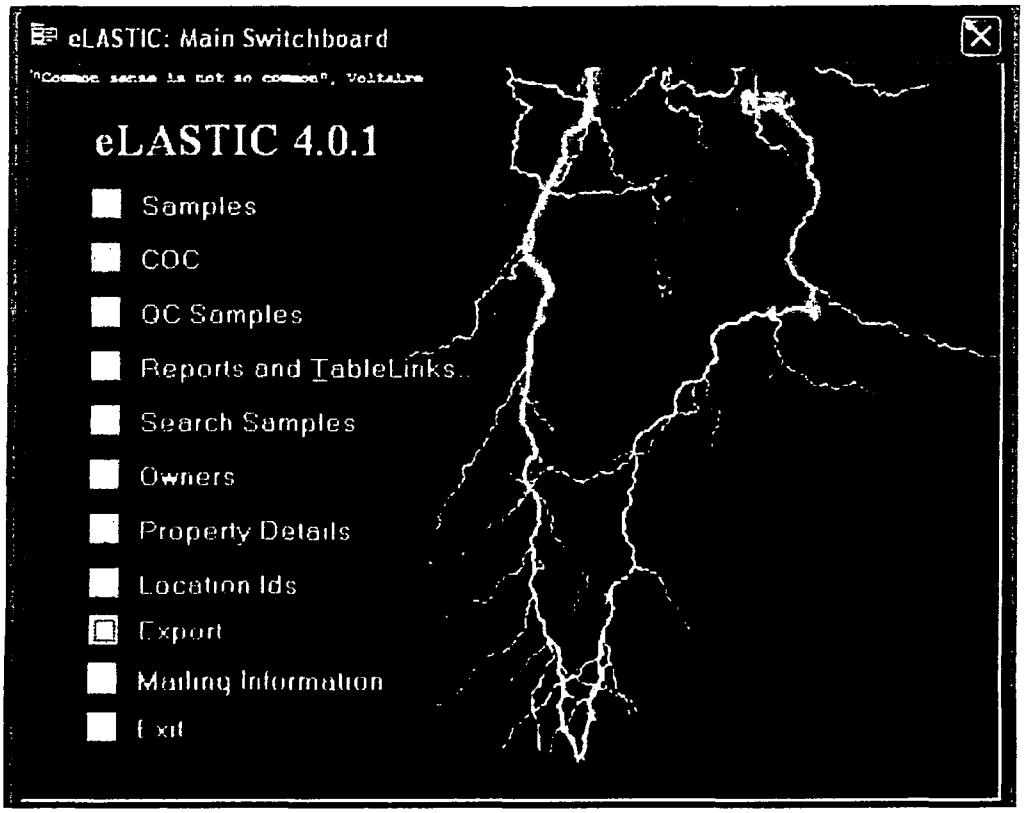
April, 2007

Section 1: Introduction

The Electronic Libby Asbestos Sample Tracking Information Center (eLASTIC) was developed to track property and sample information collected at properties in and around Libby, Montana. The Switchboard, shown below, allows the user to enter new records, access existing records, and update certain information as property owners or conditions change.

Primary users of eLASTIC are data entry personnel (CDM Libby Field Office support staff), and other project staff needing to access information in support of removal design planning.

The Switchboard is the application hub:

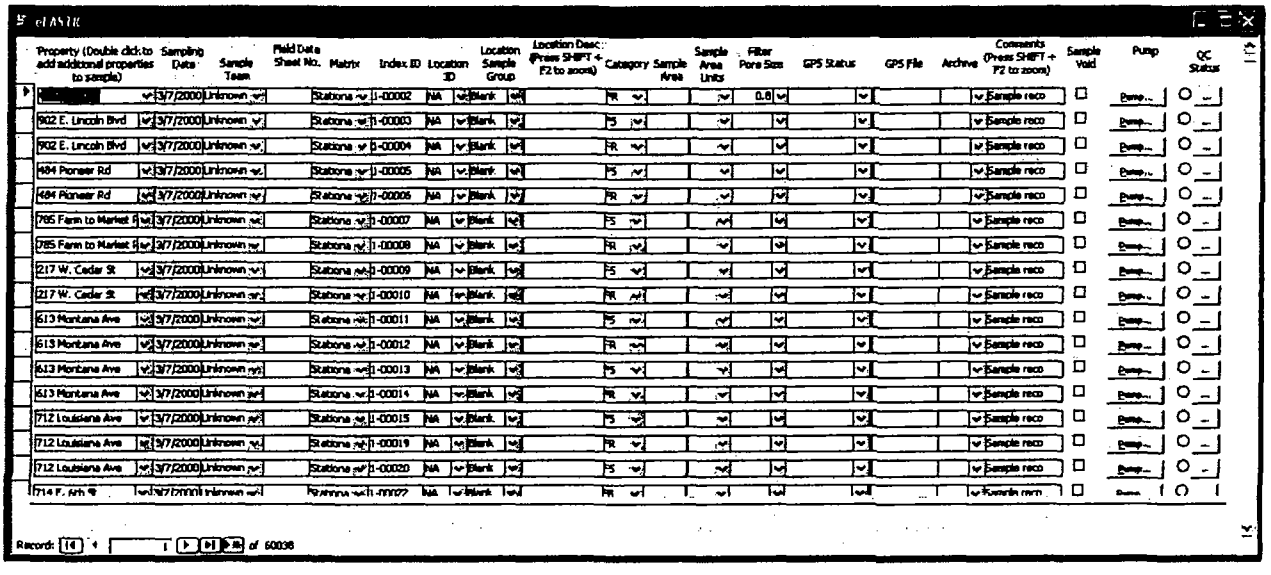


Section 2: Sample Information

The sample form allows users to enter samples into eLASTIC for tracking and chain-of-custody form (COC) generation. The following section describes the process for entering new samples, as well as details the quality control steps that ensure accuracy of entry. Section 3 describes creation of COCs.

2.1 View Sample

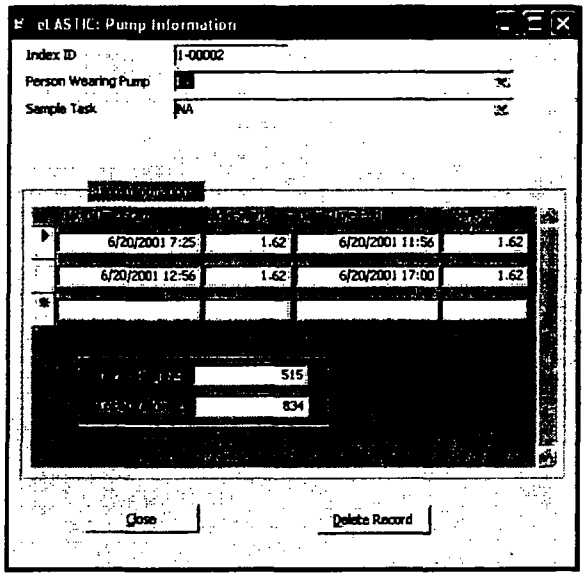
The sample form is in a spreadsheet format. The user can navigate through the records by using the scroll bar, the navigation bar at the bottom of the form, or by using the search function.



To view samples:

1. From the Switchboard click Samples.
2. Place the cursor in the column you want to search on.
3. Press CTRL + F to open the Find Dialog form.
4. Type the text you want to search for and click Find

Pump information is available for samples that require the use of a pump. The pump form contains pump information about the selected sample.



To view the pump information:

1. Click Pump...
2. To close the pump information form, click Close.

2.2 Add Sample

Immediately after samples are relinquished from a sampler to the CDM sample coordinator (or designate), sample information is entered from the field sample data sheet (completed by the sampler and relinquished along with the samples) into eLASTIC using the following procedure:

To add a sample:

1. With the Sample Form open, click the >* button on the navigation bar in the lower left-hand corner of the form. This navigates the cursor to a new record.
2. Select the property from the drop-down box that corresponds to the sample.
    a. If the property is not available in the drop-down box then see section 4.2.
3. Enter the sample date in the Sampling Date column.
4. Enter the sample team in the Sample Team column.
5. Enter the Field Data Sheet number in the Field Data Sheet No. column if applicable.
6. Enter the sample matrix from the Matrix drop-down box.
7. Enter the Index ID in the Index ID column.
8. Select the location ID from the Location ID drop-down box.
    a. If the location ID is not available in the drop-down box, type the new location ID in the box and press the tab key. A message will appear indicating that no record of this location ID exists. Click Ok to continue.
9. Select the location sampling group from the Location Sample Group drop-down box.
10. Enter the location description in the Location Desc box. (Note: the box can be expanded by pressing SHIFT+F2).

11. Select the sample category from the Category drop-down box.

If the sample does not require area then proceed to step 14.

12. Enter the sample area in the Sample Area column.
13. Select the sample area units from the Sample Area Units drop-down box.
14. Select the filter pore size from the Filter Pore Size drop-down box.
15. Enter the GPS status from the GPS Status drop-down box.
16. Enter the GPS file in the GPS File column.
17. If the sample is an archive sample, then select 'Y' from the Archive drop-down box.
18. Enter the sample comments in the Comments column. (Note: the box can be expanded by pressing SHIFT+F2).
19. If the sample is void, then check the Void checkbox.

If the sample requires pump information then complete the following steps:

20. For pump information click Pump.... This opens the Pump Information form.
21. Select the name of the person who wears the pump from the Person Wearing Pump drop-down box.
22. Select the sample task from the Sample Task drop-down box.
23. Enter the date/time start of the pump in the Date/Time Start column. Use mm/dd/yy hh:mm format.
24. Enter the date/time end of the pump in the Date/Time Stop column. Use mm/dd/yy hh:mm format.
25. Enter the pump flow starting value in the Flow Start column.
26. Enter the pump flow stopping value in the Flow Stop column.

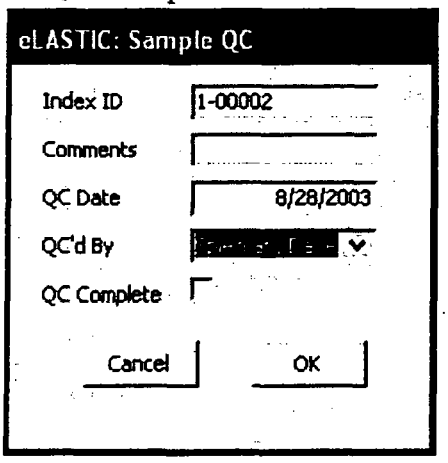
Note: If there are multiple date/time intervals repeat steps 20-23. The total minutes and total volume are calculated based on the values entered in the preceding steps.

27. Click Close to navigate back to the Sample form.

2.3 Quality Control Checks on Data Entry

To ensure that sample information is entered accurately from the field sample data sheet, eLASTIC requires that an independent party review all entered information before it can be used to create a COC or be exported to other sources (such as the Libby V2 database). This is called "Sample QC" in the sample form. The reviewer is also required to enter their initials for each sample record checked, thus making a permanent record of the quality check associated with the sample.

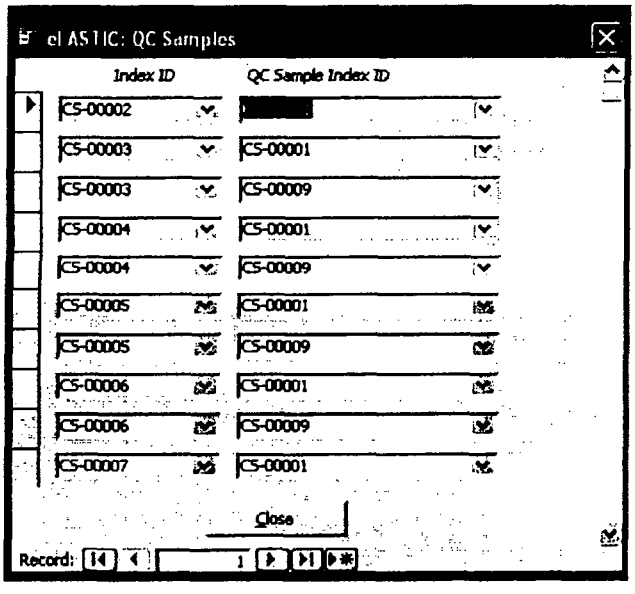
To QC a sample record:



1. Navigate to the sample.
2. Review the data entry for each field against the Field Data Sheet.
    a. If there are any errors, then make the appropriate changes.
3. When the review is complete, click the ... button on the right-hand side of the form. This opens the Sample QC form
4. Enter any comments in the Comments box. (Note: the box can be expanded by pressing SHIFT+F2).
5. Enter the date the QC is complete.
6. Select the name of the person who reviewed the sample in the QC'd By box.
7. Check the QC Complete box.

2.4 Quality Control Sample Association

eLASTIC allows for tracking of certain types of field QC samples by the sample coordinator (or designate). For soil samples, the user can associate a field duplicate or split to its parent field sample, or associate an equipment blank to field samples collected by the same field team. Other media QC samples are not required to be tracked at this time; however, as project requirements change, the QC Sample Association tool can be implemented as necessary for field blanks, rinsates, and the like.



To assign QC samples:

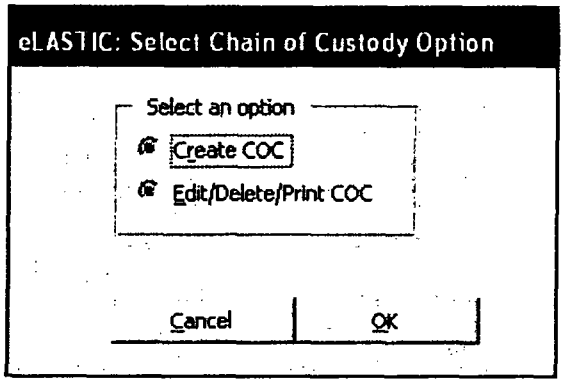
1. From the Switchboard click QC Samples. This opens the QC Samples form.
2. Click the >* button on the navigation bar in the lower left-hand corner of the form. This navigates the cursor to a new record.
3. Select the Target (non-QC) sample from the Index ID drop-down box.
4. Select the QC sample from the QC Sample Index ID drop-down box.
5. Repeat steps 2-4 for additional associations.
6. Click Close to exit.

Section 3: Chain-Of-Custody Information

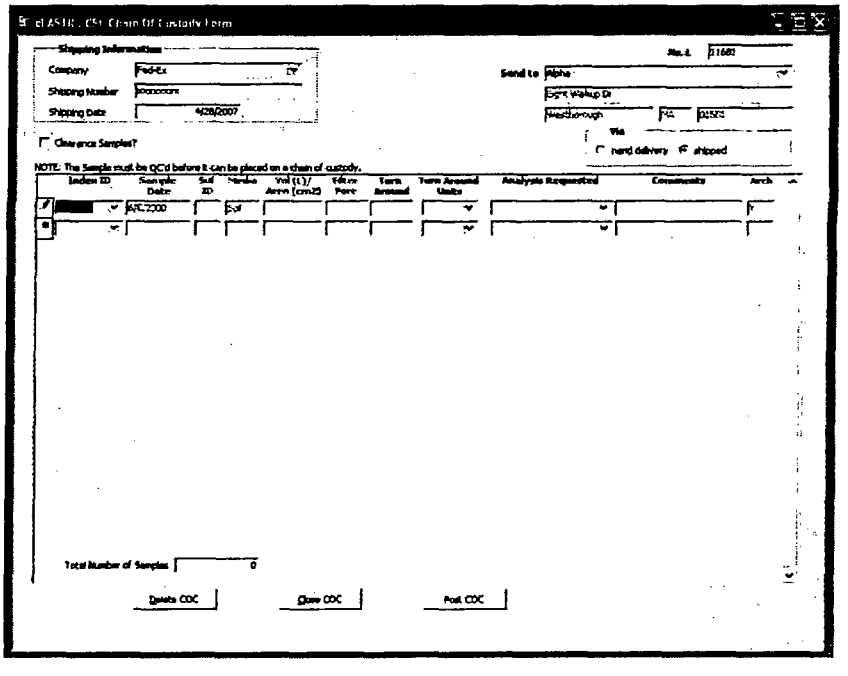
COCs document custody and condition of samples from collection, to analysis, to final archive. COCs are generated for all Libby project samples using information from the Sample Form, along with shipping and analysis information selected by the user. The following section describes how to create, edit, or delete a COC, as well as how to "post" the COC information in order to create an export file for upload to the Libby V2 database.

3.1 Create COC

To create a COC:



1. From the Switchboard click COC. This opens the Select Chain of Custody Option dialog box.
2. Select the Create COC option, and click OK.
3. This opens the Chain Of Custody form with a new Chain Of Custody ID. The ID is located in the upper right-hand portion of the form in the No. L box. (Note: The number is automatically created incrementally based on the highest number in the database.)
4. Select the Laboratory where the samples are to be sent from the Send To drop-down box.
5. Select the shipping company from the Company drop-down box.
6. Enter the shipping number in the Shipping Number box.
7. Enter the shipping date in the Shipping Date box.
8. If the samples are clearance samples, check the Clearance Samples check box.
9. Select the sample from the Index ID drop-down box.
10. Enter the turn around time in the Turn Around box.



11. Select the turn around time units in the Turn Around Units drop-down box.
12. Select the analysis to be performed in the Analysis Requested drop-down box.
13. Enter any comments that are associated with the request in the Comments box. (Note: the box can be expanded by pressing SHIFT+F2).
14. Repeat steps 8-12 for any additional samples that are to be assigned to that particular chain-of-custody.
15. To close the chain-of-custody click close.

3.2 Edit/Delete/Print COC

COCs can be printed as needed by any eLASTIC user; however this function is primarily used by the CDM sample coordinator. COCs can also be deleted, in the event that samples do not need to be submitted, or edited, in the event of a transcription error from the field sample data sheet.

To edit/delete/print a COC:

1. From the Switchboard click COC. This opens the Select Chain of Custody Option dialog box.
2. Select the Edit/Delete/Print COC option, and click OK.
3. Select the COC from the Select COC to edit dialog box and click OK.

To edit:

a. If the COC has been posted, click Unlock COC.
b. Edit as necessary.

To delete:

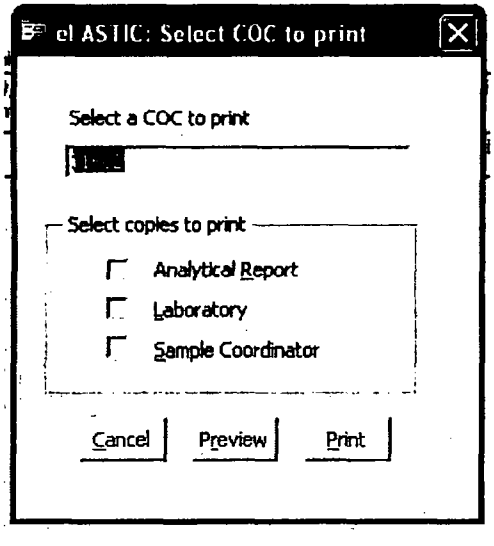
a. If the COC has been posted, click Unlock COC.
b. Click Delete COC.

To print:

a. Click Print COC.
b. Select the copies that are to be printed.
c. Click Preview to preview the COC.
d. Click Print to print the COCs.
e. Click Cancel to exit.

3.3 Post COC

COC information is exported from eLASTIC and emailed to the Volpe Center by the CDM sample coordinator on a daily basis. This process allows analysis request and analytical laboratory information to be populated into Libby V2 to allow users outside of Libby to track sample custody.



To post a COC:

1. With the chain-of-custody open that is to be posted, click Post COC. (Note: If the Post COC function has already been

performed, the button will display "Unlock COC". In this case, click Unlock COC, and then click Post COC.) This opens the COC to print dialog.

2. Select the copies that are to be printed.
3. Click Preview to preview the COC.
4. Click Print to print the COCs.
5. Click Cancel to exit.
6. Click Close to close the COC.

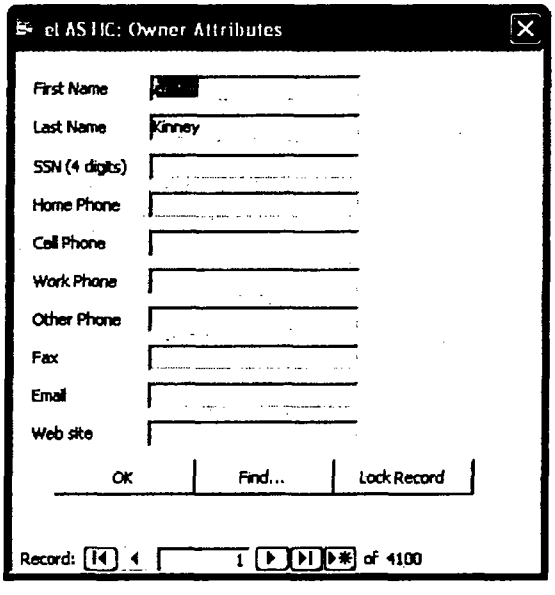
Section 4: Owner and Address

Property owner and address information changes as real estate transactions occur. New owner information can be captured, or existing owner information changed, to keep eLASTIC data current. Address additions and updates are handled in a similar manner. **Note: It is imperative that the user check the existing owner names and addresses, and cross-check possible idiosyncrasies in the entry of those names and addresses, to prevent duplication of entries.**

The following section describes the process to add or edit owner names and addresses.

4.1 Add/Edit Owner

To add or edit owner:



1. From the Switchboard click Owners.

To Add:

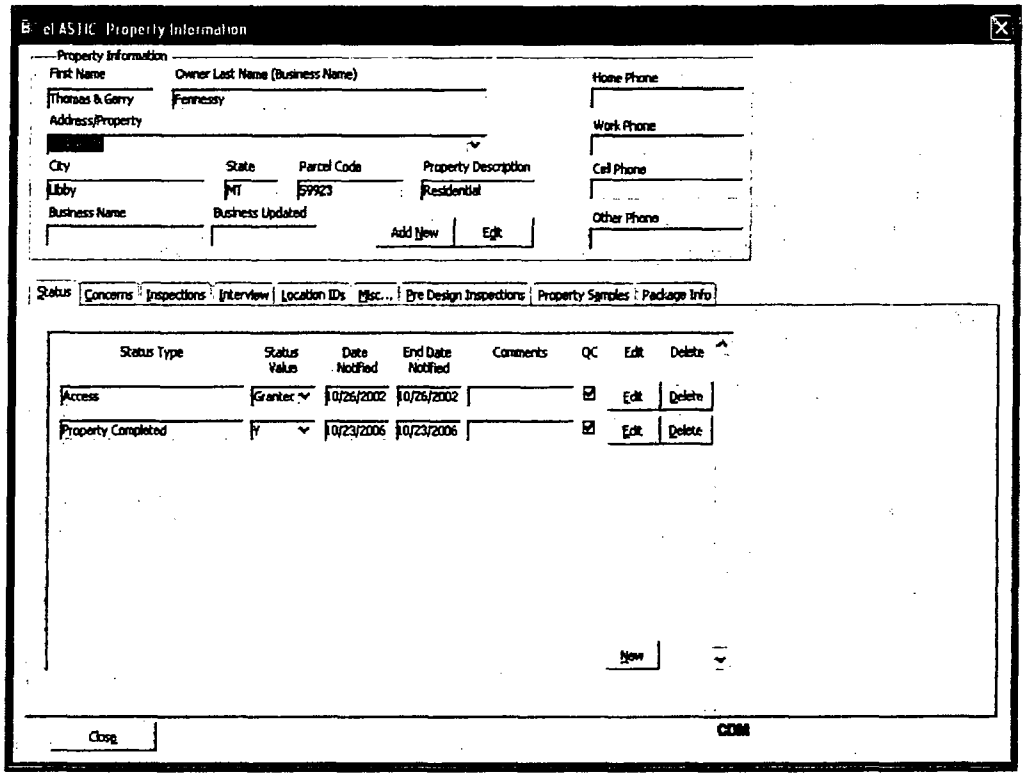
a. To add an owner click the >* button on the navigation bar in the lower left-hand corner of the form. This navigates the cursor to a new record.
b. Enter the first name of the owner in the First Name box.
c. Enter the last name of the owner in the Last Name box.
d. Enter the last 4 digits of the owner's SSN in the SSN box.
e. Enter the home phone number in the Home Phone box.
f. Enter the cell phone number in the Cell Phone box.
g. Enter the work phone number in the Work Phone box.
h. Enter any other phone number in the Other Phone box.
i. Enter the fax number in the Fax box.
j. Enter the email in the Email box.
k. Enter the website in the Web site box.
l. Click OK to close.

To Edit:

a. To edit an owner click Find. This opens the Find Dialog form.
b. Enter the last name, and click Find Next.
c. Click Cancel once the record has been located.
d. Click Unlock Record to begin editing.
e. Once the record has been edited click Lock Record.
f. Click OK to close.

4.2 Add/Edit Address

To add a new property or edit an existing property:



1. From the Switchboard select Property Details.

To Add:

a. To add a property click Add New.
b. Select the Owner from the Owner drop-down box.
c. Enter the address in the Address box.
d. *If the city, state, or parcel-code is different than the defaulted values, then* change as necessary.
e. Select the property description from the Property Description drop-down box.
f. If the property is a business, enter the business name in the Business Name box.
g. If the date the business name was updated is different than the current date, enter the date of update in the Business Updated box.
h. Check the NeedToSendToVolpe and Revision check boxes as appropriate. See note below.
i. Click Ok to add the record, or Cancel to cancel record.

(Note: If the property is new to the database, by default the NeedToSendToVolpe check box is checked and the Revision check box is not

checked. If the property is being edited instead of added as a new property to the database, both check boxes are checked. The values of these check boxes should not be altered from their default values unless there is a specific need to do so)

To Edit:

a. Select the property from the Address/Property drop-down box.
b. Click Edit. This opens the Property Information form.
c. Edit as necessary.
d. Click Ok to update the record, or Cancel to cancel the update.

4.3 Property Information

The Property Information screen is used to look up or edit property details, such as owner name, owner concerns, access status, inspections performed, and comments about contacts or previous owners. The information for a specific property is displayed through the following:

To access property information:

1. From the Switchboard select Property Details.
2. Select the property from the Address/Property drop-down box.

4.3.1 Property Status

The Property Status screen captures Access Status information, allows for field override of remediation status as determined by the remediation status query from Libby V2, and tracks when remediation is complete at a property. ***Separate records are entered for each of these data items.*** The user can add, edit, or delete records, but it should be noted that a status should only be deleted if the record was entered incorrectly (e.g., on an incorrect property).

Access Status defines if and where we're allowed to do work at a property. For Access Status, there are five values available when entering a new property or editing an existing property. These are:

TBD (to be determined) - 1) the owner has contacted CDM and requested investigation, but an Access Agreement is not yet signed; or 2) the property is vacant and CDM is unable to contact the owner to obtain access

Granted - the owner has signed an Access Agreement

Partial - 1) the owner has signed and Access Agreement with contingency; or 2) the owner has signed an Access Agreement but has halted work at some point

Denied - the owner has not granted access to the property

5 Attempts - CDM has called the owner or stopped by the property (non-vacant) a total of 5 times

Remediation Status Override (Interior or Exterior) is used by designated field team members who are able to make the final determination that, based on current field conditions, a property does or does not require remediation even though previously-collected data indicates otherwise. This decision is typically made by a PDI team member.

The Property Complete status is populated when removal and restoration activities are complete at a property. This data is taken from the Property Closeout Checklist and entered by a data entry team member.

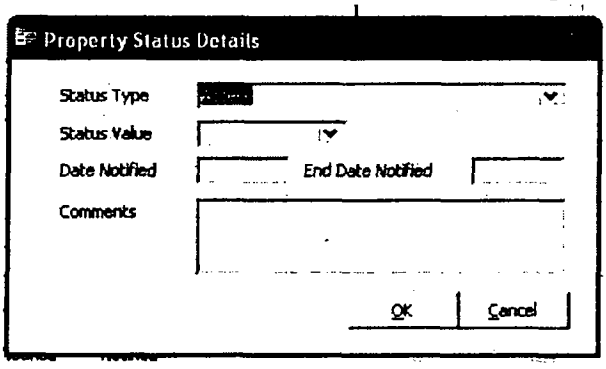
The following describes Property Status in more detail.

To access Property Status:

1. Click the Status tab.

To add a status:

1. Click New
2. Select the status type from the Status Type drop-down box.



3. Select the status value from the Status Value drop-down box.
4. Enter the date notified in the Date Notified box.
5. If there is a date range for date notified, then enter the ending date of the range in the End Date Notified box. The value defaults to the Date Notified box value.
6. Enter any comments in the Comment box.
7. Click OK.

To edit a status:

1. Click Edit.
2. If the status has been QC'd, a message will appear indicating the QC has been completed. Click yes to continue.
3. If the status has been exported a message will appear indicating a revision file will need to be sent. Click yes to continue.
4. Edit as necessary.
5. Click OK.

To delete a status:

1. Click Delete.
2. If the status has been exported:
    a. A message will appear indicating a revision file must be sent. Click Yes.
    b. A dialog box will ask for a name for the export file. A default name is provided. Click OK.

c. A warning message will appear "You are about to update 1 record...". Click OK.
d. A message will appear "Export Successful." Click OK.

3. If the status has been QC'd:
   a. A message will appear indicating the QC has been complete. Click yes to continue.
4. A warning message will appear "You are about to delete 1 record..." Click Yes.

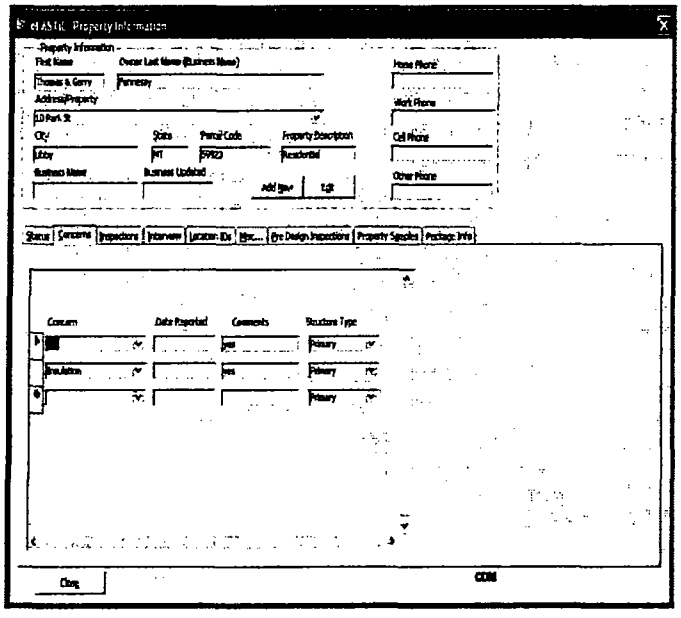
To QC a status:

1. Review the status as indicated in the appropriate documentation.
2. Check the QC box.

4.3.2 Property Concerns

On occasion, an owner that has not had any investigation work done at their property will contact CDM with a property concern. eLASTIC is set up to capture concerns (such as kids, soil, or insulation) via the Property Concern screen.

To access Property Concerns:



1. Click the Concerns tab.

To add a concern:

1. Select the concern from the Concern drop-down box.
2. Enter the date the concern is reported in the Date Reported box.
3. Enter any comments associated with the concern in the Comments box. (Note: the box can be expanded by pressing SHIFT+F2).
4. Select the structure type from the Structure Type drop-down box.

To edit a concern:

1. Select the record to edit.
2. Edit as necessary.

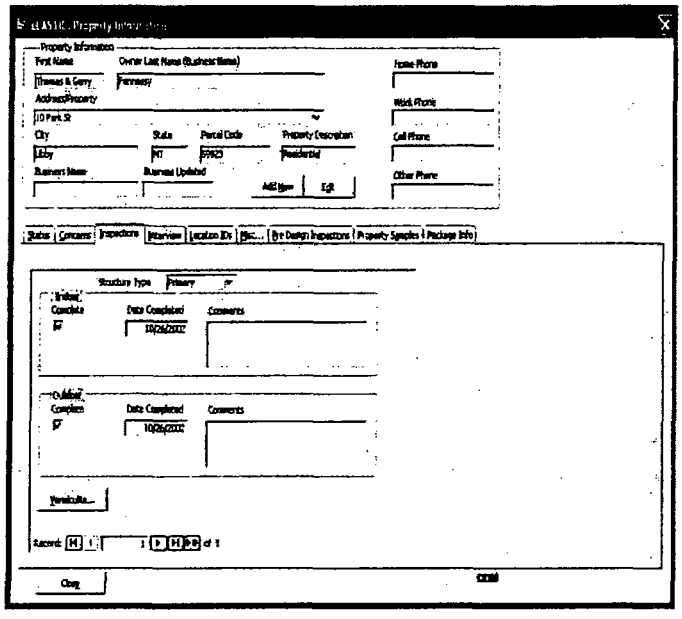
To delete a concern:

1. Select the record to delete by clicking the record selector.
2. Press DELETE.
3. A warning message will appear "You are about to delete 1 record..." Click Yes.

4.3.3 Property Inspections

Property inspection information recorded during the Contaminant Screening Study (CSS) on the Information Field Form is entered into eLASTIC via the Inspections screen. Required information to be entered in this screen consists of: checkboxes indicating the indoor and/or outdoor CSS inspections were performed; the date (or dates) the inspections were performed; to which building the inspection information is tied (primary, meaning main residence; secondary, meaning outbuildings); and the location of any vermiculite observed on the property. Comments pertaining to the CSS can also be entered here. A common use of the comments field is to track access to one part of the property but not to another (i.e., outdoor sampling granted but no indoor investigation wanted).

To access Property Inspections:



1. Click the Inspections tab.

To add an inspection:

1. Click the >* button on the navigation bar inside the inspection tab.
2. Select the structure type in the Structure Type drop-down box.
3. For indoor inspections:
    a. Check the Indoor Complete checkbox.
    b. Enter the date of the inspection in the Date Completed box.
    c. Enter any comments in the Comment box.
4. For outdoor inspections:
    a. Check the Outdoor Complete checkbox.
    b. Enter the date of the inspection in the Date Completed box.
    c. Enter any comments in the Comment box.
5. If there is vermiculite to report click the Vermiculite button. This opens the Vermiculite Location Details form.
    a. Select the structure type from the Structure Type drop-down box.
    b. Select indoor/outdoor from the Indoor/Outdoor drop-down box.
    c. Select value from the Is vermiculite present drop-down box.
    d. Select the location of vermiculite from the Location of Vermiculite drop-down box.
    e. Enter any comments in the Comments box.

f. Click Close.

To delete an inspection:

1. Place the cursor in the Structure Type drop-down box.
2. Select menu item: Edit ->Delete Record.
3. A warning message will appear "You are about to delete 1 record...". Click Yes.

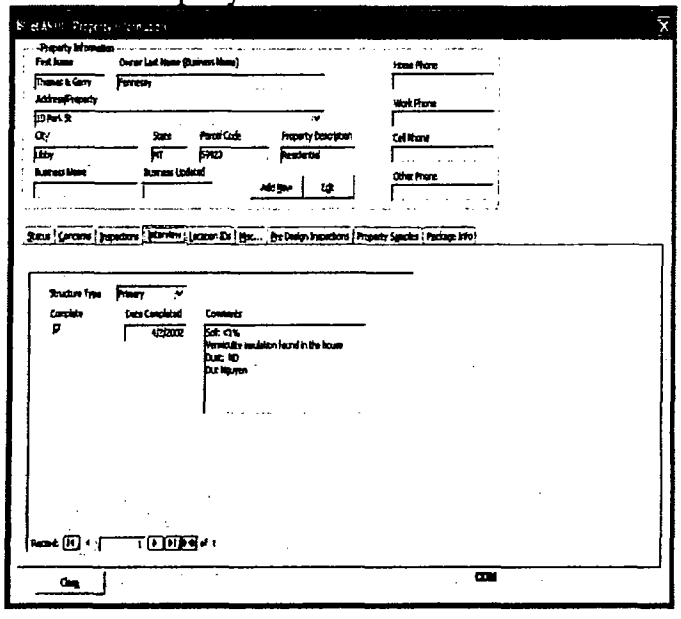
To edit an inspection:

1. Select the record to edit.
2. Edit as necessary.

4.3.4 Property Interviews

On the occasion that EPA or an EPA representative meets with an owner to discuss matters regarding their property, the meeting or "interview" is tracked in eLASTIC. The date of the interview, as well as pertinent topics of discussion, is entered in the Property Interview screen.

To access Property Interviews:



1. Click the Interview tab.

To add an interview:

1. Click the >* button on the navigation bar inside the interview tab.
2. Select the structure type in the Structure Type drop-down box.
3. Check the Complete checkbox.
4. Enter the date the interview was done in the Date Completed box.
5. Enter any comments in the comment box.

To delete an interview:

1. Place the cursor in the Structure Type drop-down box.
2. Select menu item: Edit ->Delete Record.
3. A warning message will appear "You are about to delete 1 record...". Click Yes.

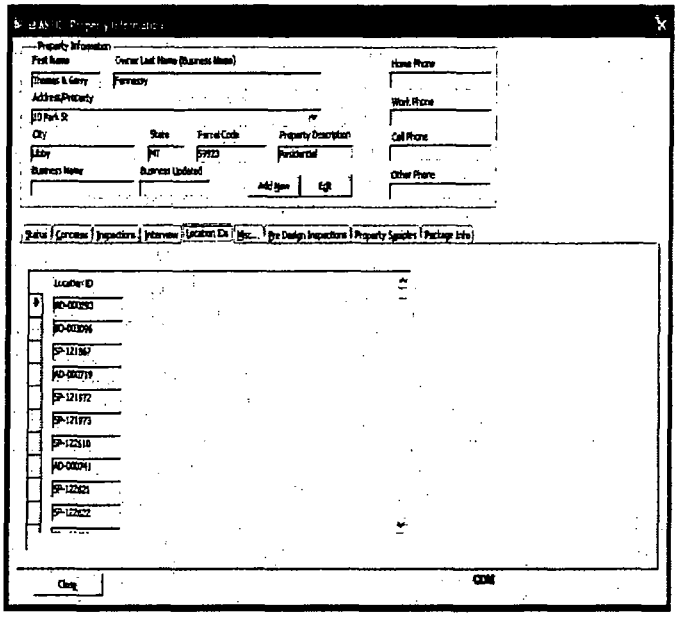
To edit an interview:

1. Select the record to edit.
2. Edit as necessary.

4.3.5 Location IDs

There are three varieties of location IDs: building (BD), property (AD), and sample (SP). The rules for assigning location IDs can be found in the Location ID Business Rules document, prepared by Volpe, dated 3/25/02.

To access Location IDs:



1. Click the Location IDs tab.

To add a location ID:

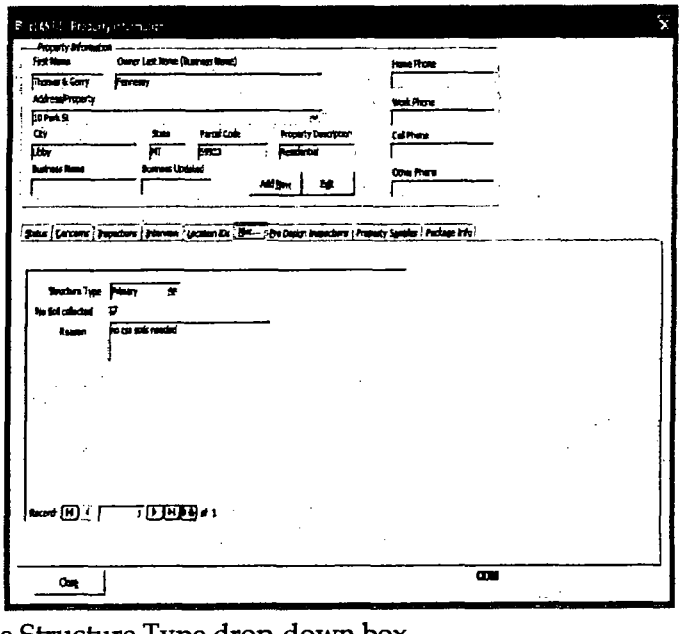
1. Enter the location ID in the Location ID box

To delete a location ID:

1. Select the location ID to delete by clicking the record selector.
2. Press DELETE.
3. A warning message will appear "You are about to delete 1 record...". Click Yes.

4.3.6 Miscellaneous (i.e., No Soil Collected)

The Miscellaneous screen is used to note properties where Phase 1 soil samples fully characterized the outdoor portion of a property, deeming CSS soil sampling unnecessary. This is important to track because the assumption could be drawn that if no CSS soil samples appear for a property, that the samples still need to be collected when in fact, none need to be collected.



To access Miscellaneous:

1. Click the Misc tab.

To add a record:

1. Click the >* button on the navigation bar inside the Misc tab.
2. Select the structure type in the Structure Type drop-down box.

3. Check the No Soils Collected checkbox.
4. Enter the reason in the Reason box.

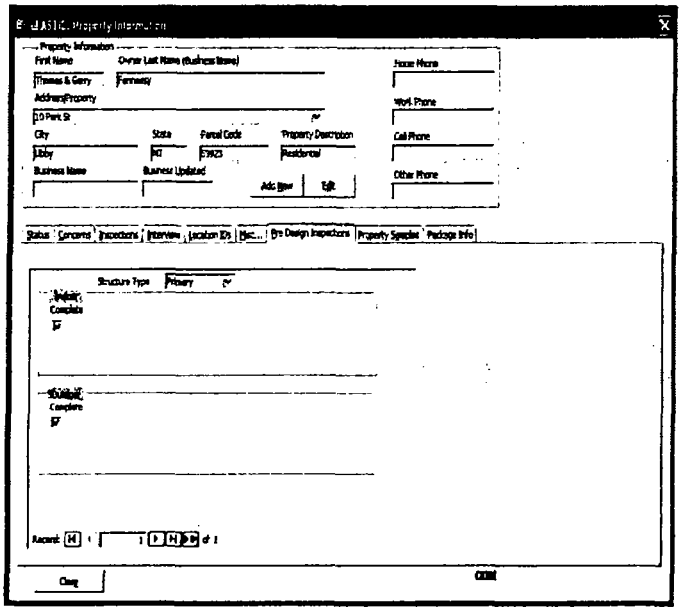
To delete a record:

1. Place the cursor in the Structure Type drop-down box.
2. Select menu item: Edit ->Delete Record.
3. A warning message will appear "You are about to delete 1 record...". Click Yes.

4.3.7 Pre-Design Inspections

Property inspection information recorded during the Pre-Design Inspection on a Supplemental Interior Inspection Checklist (SIIC) and/or Exterior Inspection Checklist (EIC) is entered into eLASTIC via the Pre-Design Inspections screen. Required information to be entered in this screen consists of: checkboxes indicating the indoor and/or outdoor pre-design inspections were performed; the date (or dates) the inspections were performed; and to which building the inspection information is tied (primary, meaning main residence; secondary, meaning outbuildings).

To access Pre-Design Inspections:



1. Click the Pre Design Inspections tab.

To add a record:

1. Click the >* button on the navigation bar inside the Pre Design Inspections tab.
2. Select the structure type in the Structure Type drop-down box.
3. For indoor inspections:
   a. Check the Indoor Complete checkbox.
4. For outdoor inspections:
   a. Check the Outdoor Complete checkbox.

To delete a record:

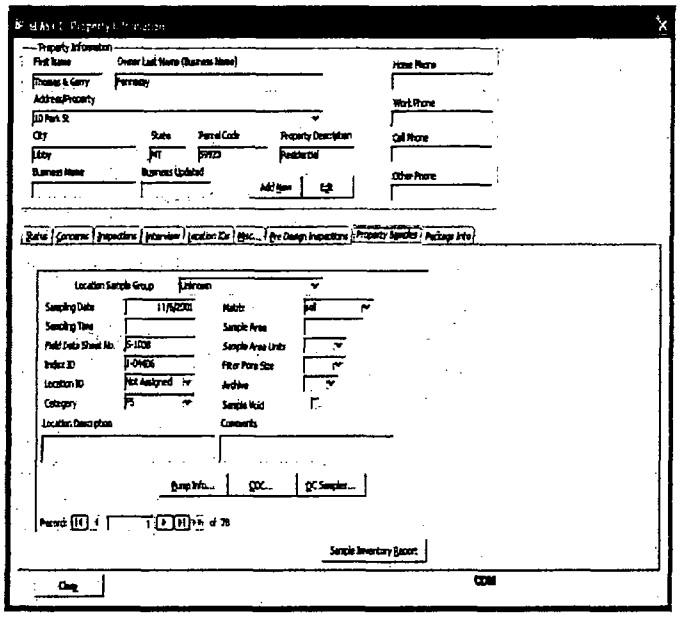
1. Place the cursor in the Structure Type drop-down box.
2. Select menu item: Edit ->Delete Record.
3. A warning message will appear "You are about to delete 1 record...". Click Yes.

4.3.8 Samples by Property

With this function, users can alter, edit, and review details about the samples collected at a specific property. The information displayed in the Property Samples tab is derived

from the sample information entered for each property via the Samples form. See section 2 for details.

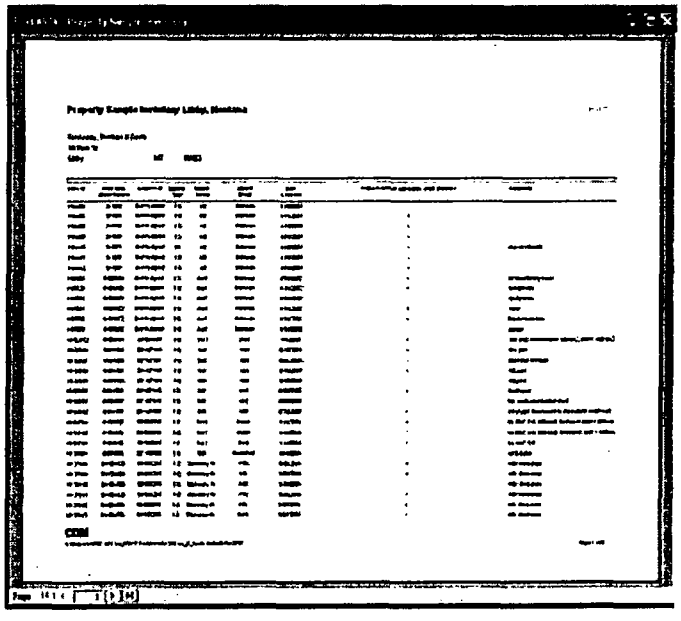
To access samples by a property:



1. Click the Property Samples tab.
2. Use the record navigator bar at the bottom of the form to browse the samples.
3. Click Pump Info... for the pump information.
4. Click COC... for chain-of-custody information.
5. Click QC Samples to view QC sample associations.

4.3.8.1 Sample Inventory Report

To view a summary of information for samples collected at a property, users can print a Sample Inventory Report specific to that property. (Note: This functionality can also be found by clicking on Reports and TableLinks on the Switchboard, then clicking on Sample Report.)



To print a Sample Inventory Report:

1. Click Sample Inventory Report. This displays the report in Print Preview.
2. Select menu item: File ->Print to print report.

4.3.8.2 Pump Info

Pump information is available for samples that require the use of a pump. The pump form contains pump information about the selected sample.
(Note: The Pump Information form is also accessible via the Samples form. See section 2.1 for details)

To view the pump information:

1. Click Pump Info...
2. To close the pump information form, click Close.

4.3.8.3 COC

Chain of Custody information is available for properties from which samples have been taken. The Chain of Custody Query window contains COC information for the selected sample.

To view the COC information:

1. Click COC...
2. To close the COC Query window, use the standard windows close button.

4.3.8.4 QC Samples

eLASTIC allows for tracking of certain types of field QC samples by the sample coordinator (or designate). For soil samples, the user can associate a field duplicate or split to its parent field sample, or associate an equipment blank to field samples collected by the same field team. The QC sample form contains QC sample information about the selected sample.
(Note: The QC sample information is also accessible via the QC Samples form. See section 2.4 for details)

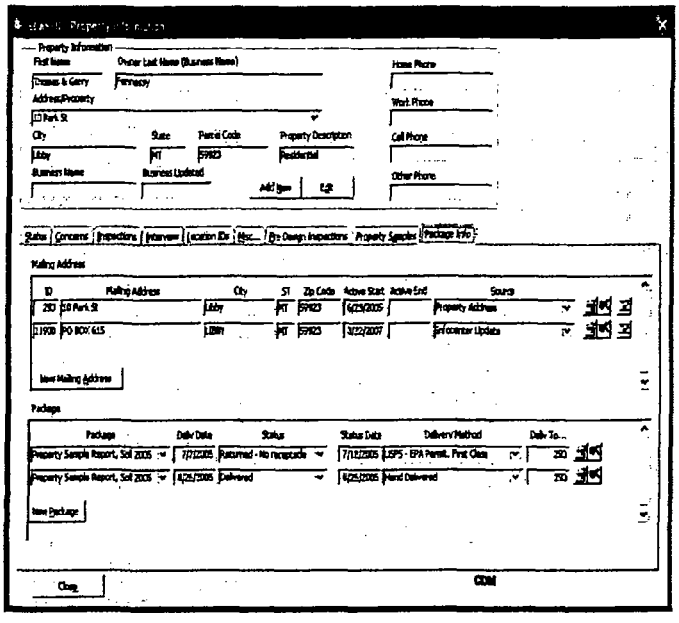
To view the QC samples information:

1. Click QC Samples...
2. To close the QC samples form, click Close.

4.3.9 Package Info

Available mailing addresses and information about specific packages associated with each address are available for entry, edit, and alteration via the Package Info screen. For each primary address associated with an owner, multiple mailing addresses can exist. For example, an owner with a home mailing address can also have a PO Box. For each mailing address, multiple packages can exist. For example, several packages can be sent to an owner's home address, and several other packages can be sent to the owner's PO Box.

To access package information by a property:



1. Click the Package Info tab.

To add a new mailing address:

1. Click the New Mailing Address button in the Mailing Address section.
2. Select the source of the new mailing address from the Source drop-down box.
3. Enter the new address in the Address box.
4. If the city or state is different than the defaulted values, then change as necessary.
5. Enter the ZIP code of the new address in the ZIP Code box.
6. Enter the date the new address will become active in the Active Date Start box.
7. Enter the date (if any) the new address will become inactive in the Active Date End box.
8. Click Ok to complete the entry, or Cancel to cancel the entry.

To add new package delivery information:

1. Click the New Package button in the Package section.
2. Select the address to which the new package is to be mailed from the Address drop-down box.
3. Select the package type from the Package drop-down box.
4. Select the delivery status from the Delivery Status drop-down box.
5. Enter the date the delivery status is determined in the Delivery Status Date box.
6. Select the delivery method from the Delivery Method drop-down box.
7. Enter the date of delivery in the Delivery Date box.

There are shortcut tool buttons associated with each Mailing Address and Package. The available buttons are as follows:

Delete:  Edit:  Add to Mail Queue: 

To delete an address or package, click the delete button next to the address or package that needs to be deleted. To edit an address or package, click the edit button next to the address or package that needs to be edited. To add an address to the mailing label queue, click the Add to Mail Queue button.

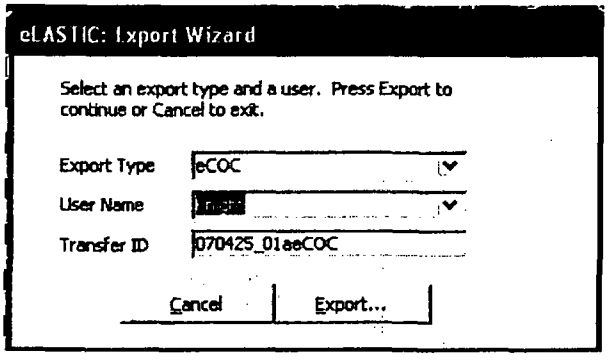
Section 5: Exports

In order to avoid duplication of data entry, and provide an additional level of quality assurance, certain data is exported from eLASTIC and sent to Volpe for upload to the Libby V2 database. Data exports are performed by the CDM sample coordinator on a daily basis to ensure consistent and timely exchange of data between the two databases. The following section describes the three export processes.

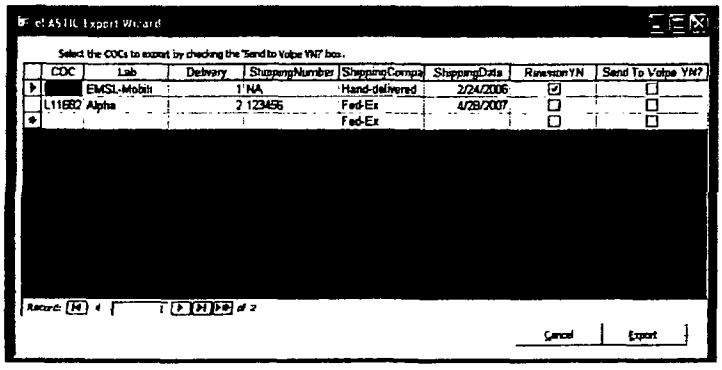
5.1 eCOC Export

This export transfers COC data.

To export eCOC:



1. Click Export from the Switchboard. This opens the Export Wizard dialog box.
2. Select eCOC from the Export Type drop-down box.
3. Select the user name from the User Name drop-down box.
4. Enter a transfer ID in the Transfer ID box. It is recommended to use the default value that is provided.
5. Click Export. This opens the eCOC Export form.



6. Select the COCs to export by checking the 'Send To Volpe YN?' checkbox for the respective COC.
7. *If the COC is a* revision, then click the 'Revision YN' checkbox.
8. Click Export.

5.2 ePS Export

This export transfers Property Status data.

To export ePS:

1. Click Export from the Switchboard. This opens the Export Wizard dialog box.
2. Select ePS from the Export Type drop-down box.
3. Select the user name from the User Name drop-down box.

4. Enter a transfer ID in the Transfer ID box. It is recommended to use the default value that is provided.
5. Click Export. This opens the ePS Export form.
6. Select the property to export by checking the 'Send To Volpe YN?' checkbox for the respective COC.
7. Click Export.

5.3 SAMPLOAD Export
This export transfers sample data.

To export SAMPLOAD:

1. Click Export from the Switchboard. This opens the Export Wizard dialog box.
2. Select SAMPLOAD from the Export Type drop-down box.
3. Select the user name from the User Name drop-down box.
4. Enter a transfer ID in the Transfer ID box. It is recommended to use the default value that is provided.
5. Click Export. This initiates the export process.
6. A warning dialog box will appear "You are about to..." Click Yes.
7. A warning dialog box will appear "You are about to append..." Click Yes.

5.4 QAMRPT Export
This export transfers Quality Assurance Management data.

To export QAMRPT:

1. Click Export from the Switchboard. This opens the Export Wizard dialog box.
2. Select QAMRPT from the Export Type drop-down box.
3. Select the user name from the User Name drop-down box.
4. Enter a transfer ID in the Transfer ID box. It is recommended to use the default value that is provided.
5. Click Export. This opens the Weekly Progress Report Export form.
6. Enter the start and end date ranges for the report.
7. Click Continue. This initiates the export process.
8. An information dialog box will appear "Export Successful". Click Ok.

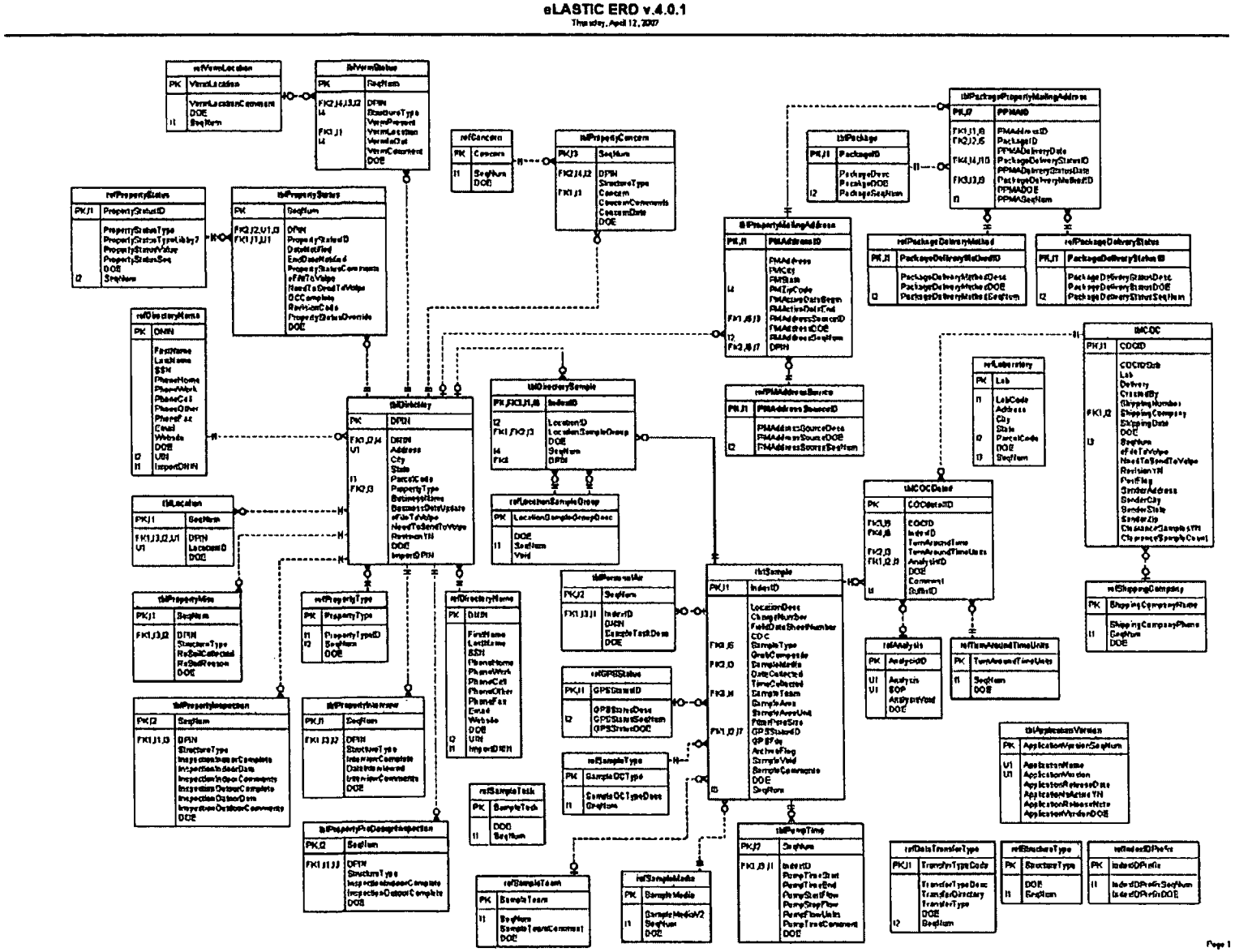
5.5 eProperty Export
This export transfers new property data.

To export eProperty:

1. Click Export from the Switchboard. This opens the Export Wizard dialog box.
2. Select eProperty from the Export Type drop-down box.
3. Select the user name from the User Name drop-down box.
4. Enter a transfer ID in the Transfer ID box. It is recommended to use the default value that is provided.
5. Click Export. This opens the eProperty Export form.

6. Alter the Send File to Volpe? and Revision YN check boxes as necessary.
7. Click Export. A Microsoft Access warning dialog box will appear "You are about to update...". Click Yes.
8. An information dialog box will appear "Export Successful". Click Ok.

Appendix A: Entity Relationship Diagram



Appendix B: Data Dictionary

Table	Field	Description	Datatype	Length	Precision	Scale	Nulls	Default
refAnalysis								
refAnalysis	*AnalysisID*	Arbitrary unique sequential number used to identify record	dbLong	4			1	
refAnalysis	*Analysis*	Description of analytical method performed by laboratory	dbText	50			0	
refAnalysis	*SOP*	Standard Operating Procedure used for analysis	dbText	50			0	
refAnalysis	*AnalysisVoid*	Boolean flag that identifies if the analysis is no longer used for the project	dbBoolean	1			1	
refAnalysis	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refConcern								
refConcern	*Concern*	Type of concern expressed by a property owner	dbText	50			1	
refConcern	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refConcern	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refDataTransferType								
refDataTransferType	*TransferTypeCo*	Code for type of document to be imported/exported from the database	dbText	10			1	
refDataTransferType	*TransferTypeDe*	Description of TransferTypeCode	dbText	255			1	
refDataTransferType	*TransferDirector*	Directory where transferred files will be stored	dbText	200			1	
refDataTransferType	*TransferType*	Type of transfer to be performed (import/export)	dbText	8			1	
refDataTransferType	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refDataTransferType	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refDirectoryName								
refDirectoryName	*DNIN*	Directory Name Identification Number	dbLong	4			1	
refDirectoryName	*FirstName*	First name of person in directory	dbText	100			1	
refDirectoryName	*LastName*	Last Name of person in directory	dbText	100			0	
refDirectoryName	*SSN*	Social Security Number	dbText	50			1	
refDirectoryName	*PhoneHome*	Home Phone number of person in directory	dbText	10			1	
refDirectoryName	*PhoneWork*	Work phone number of person in directory	dbText	10			1	
refDirectoryName	*PhoneCell*	Cell phone number of person in directory	dbText	10			1	
refDirectoryName	*PhoneOther*	Other phone number of person in direcotry	dbText	20			1	
refDirectoryName	*PhoneFax*	Fax number for person in directory	dbText	10			1	
refDirectoryName	*Email*	email address of person in directory	dbText	50			1	
refDirectoryName	*Website*	Website address of person in directory	dbText	50			1	
refDirectoryName	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refDirectoryName	*UIN*		dbLong	4			1	
refDirectoryName	*ImportDNIN*	Import directory name identification number	dbLong	4			1	
refeLASTICMember								
refeLASTICMember	*MIN*	Member Identification Number	dbLong	4			1	
refeLASTICMember	*FirstName*	First name of eLASTIC Member	dbText	50			1	
refeLASTICMember	*LastName*	Last name of eLASTIC Member	dbText	50			1	
refeLASTICMember	*Organization*	Organization that eLASTIC member belongs to	dbText	50			1	
refeLASTICMember	*Phone*	Phone number of eLASTIC member	dbText	50			1	
refeLASTICMember	*email*	email address of eLASTIC member	dbText	50			1	
refeLASTICMember	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refGPSStatus								
refGPSStatus	*GPSStatusID*		dbText	50			1	
refGPSStatus	*GPSStatusDesc*		dbText	255			1	

Table	Field	Description	Datatype	Length	Precision	Scale	Nulls	Default
refGPSStatus	*GPSStatusSeq*		dbLong	4			1	
refGPSStatus	*GPSStatusDOE*		dbDate	8			1	=Now()
refIndexIDPrefix								
refIndexIDPrefix	*IndexIDPrefix*		dbText	5			1	
refIndexIDPrefix	*IndexIDPrefixSe*		dbLong	4			1	
refIndexIDPrefix	*IndexIDPrefixD*		dbDate	8			1	=Now()
refIndexValue								
refIndexValue	*IndexValueID*		dbText	50			1	
refIndexValue	*IndexValueType*		dbText	50			1	
refIndexValue	*IndexValueSeq*		dbLong	4			1	
refIndexValue	*IndexValueDO*		dbDate	8			1	=Now()
refLaboratory								
refLaboratory	*Lab*	Laboratory Name	dbText	50			1	
refLaboratory	*LabCode*	Code for Laboratory	dbText	6			1	
refLaboratory	*Address*	Street Address for Laboratory	dbText	100			1	
refLaboratory	*City*	City where laboratory is located	dbText	50			1	
refLaboratory	*State*	State where Laboratory is located	dbText	2			1	
refLaboratory	*ParcelCode*	Parcel Code for Laboratory	dbText	10			1	
refLaboratory	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refLaboratory	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refLocationSampleGroup								
refLocationSampleGroup	*LocationSample*	Description of sample group location	dbText	50			1	
refLocationSampleGroup	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refLocationSampleGroup	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refLocationSampleGroup	*Void*	yes/no field indicating whether sample has been voided	dbBoolean	1			1	
refPackageDeliveryMethod								
refPackageDeliveryMethod	*PackageDeliver*		dbLong	4			0	
refPackageDeliveryMethod	*PackageDeliver*		dbText	100			0	
refPackageDeliveryMethod	*PackageDeliver*		dbDate	8			0	=Now()
refPackageDeliveryMethod	*PackageDeliver*		dbLong	4			1	
refPackageDeliveryStatus								
refPackageDeliveryStatus	*PackageDeliver*		dbLong	4			0	
refPackageDeliveryStatus	*PackageDeliver*		dbText	100			0	
refPackageDeliveryStatus	*PackageDeliver*		dbDate	8			0	=Now()
refPackageDeliveryStatus	*PackageDeliver*		dbLong	4			1	
refPMAddressSource								
refPMAddressSource	*PMAddressSour*		dbLong	4			0	
refPMAddressSource	*PMAddressSour*		dbText	100			0	
refPMAddressSource	*PMAddressSour*		dbDate	8			0	=Now()
refPMAddressSource	*PMAddressSou*		dbLong	4			1	
refPropertyStatus								
refPropertyStatus	*PropertyStatusI*	Arbitrary unique sequential number used to identify record	dbLong	4			1	
refPropertyStatus	*PropertyStatusT*	Type (e.g, Access, Property Completed, etc...)	dbText	50			1	
refPropertyStatus	*PropertyStatusT*	Corresponding property status type in V2 database	dbText	50			1	
refPropertyStatus	*PropertyStatusV*	Value assigned to property status (e.g, Y, N, TBD, etc...)	dbText	50			1	
refPropertyStatus	*PropertyStatusS*	Arbitrary unique sequential number used to identify a record	dbDecimal	16	18	0	1	0

Table	Field	Description	Datatype	Length	Precision	Scale	Nulls	Default
refPropertyStatus	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refPropertyStatus	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refPropertyType								
refPropertyType	*PropertyType*	Description of property	dbText	50			1	
refPropertyType	*PropertyTypeID*		dbLong	4			1	
refPropertyType	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refPropertyType	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refSampleMedia								
refSampleMedia	*SampleMedia*	Media of sample collected	dbText	50			1	
refSampleMedia	*SampleMediaV2*	Corresponding sample media in V2 database	dbText	50			1	
refSampleMedia	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refSampleMedia	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refSampleStatus								
refSampleStatus	*SampleStatus*	Sample status	dbText	50			1	
refSampleStatus	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refSampleStatus	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refSampleTask								
refSampleTask	*SampleTask*	Task performed while sample was being collected	dbText	50			1	
refSampleTask	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refSampleTask	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refSampleTeam								
refSampleTeam	*SampleTeam*	Name of team collecting samples	dbText	50			1	
refSampleTeam	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refSampleTeam	*SampleTeamCo*	Comment related to sample team	dbMemo	0			1	
refSampleTeam	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refSampleType								
refSampleType	*SampleQCType*	Quality control type of sample collected	dbText	50			1	
refSampleType	*SampleQCType*	Description of sample Quality control type	dbText	50			1	
refSampleType	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refShippingCompany								
refShippingCompany	*ShippingCompa*	Name of company shipping samples	dbText	50			1	
refShippingCompany	*ShippingCompa*	Phone number of company shipping samples	dbText	15			1	
refShippingCompany	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refShippingCompany	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refStructureType								
refStructureType	*StructureType*	Type of structure (primary/secondary)	dbText	20			1	
refStructureType	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refStructureType	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refTurnAroundTimeUnits								
refTurnAroundTimeUnits	*TurnAroundTim*	Units used for sample turn around time	dbText	10			1	
refTurnAroundTimeUnits	*SeqNum*	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
refTurnAroundTimeUnits	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()
refVermLocation								
refVermLocation	*VermLocation*	Location where vermiculite is observed	dbText	50			1	
refVermLocation	*VermLocationC*	Comment related to vermculite location	dbMemo	0			1	
refVermLocation	*DOE*	The date the record is entered in database	dbDate	8			1	=Now()

Table	Field	Description	Datatype	Length	Precision	Scale	Nulls	Default
refVermLocation	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
SQAPPIndexIDs								
SQAPPIndexIDs	Address		dbText	255			1	
SQAPPIndexIDs	IndexID		dbText	255			1	
SQAPPIndexIDs	Field3		dbDate	8			1	
SQAPPIndexIDs	Field4		dbText	255			1	
SQAPPIndexIDs	Field5		dbText	255			1	
SQAPPIndexIDs	SampleMedia		dbText	255			1	
SQAPPIndexIDs	LocationDesc		dbText	255			1	
SQAPPIndexIDs	SampleComme		dbText	255			1	
SQAPPIndexIDs	Sensitivity		dbText	255			1	
SQAPPIndexIDs	Method		dbText	255			1	
SQAPPIndexIDs	Field11		dbText	255			1	
SQAPPIndexIDs	Field12		dbDouble	8			1	
SQAPPIndexIDs	Field13		dbText	255			1	
SQAPPIndexIDs	Field14		dbDouble	8			1	
tblApplicationVersion								
tblApplicationVersion	ApplicationNam		dbText	50			0	="eLASTI
tblApplicationVersion	ApplicationVersi		dbText	10			0	
tblApplicationVersion	ApplicationRele		dbDate	8			0	
tblApplicationVersion	ApplicationIsActi		dbBoolean	1			0	False
tblApplicationVersion	ApplicationRele		dbText	255			1	
tblApplicationVersion	ApplicationVersi		dbLong	4			1	
tblApplicationVersion	ApplicationVer		dbDate	8			1	=Now()
tblCOC								
tblCOC	COCID	Identification number assigned to a Chain of custody	dbText	50			1	
tblCOC	COCIDSub	Additional suffix added to a Chain of custody number to indicate where	dbText	1			1	"L"
tblCOC	Lab	Laboratory name where samples will be sent for analysis	dbText	50			1	
tblCOC	Delivery	Type of delivery used (hand delivery of shipped)	dbInteger	2			1	
tblCOC	CreatedBy	Name of person who created Chain of Custody	dbLong	4			1	
tblCOC	ShippingNumbe	Tracking number used to track shipment	dbText	12			1	
tblCOC	ShippingCompa	Company used to ship samples	dbText	50			1	"Fed-Ex"
tblCOC	ShippingDate	Date samples were shipped	dbDate	8			1	
tblCOC	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblCOC	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblCOC	eFileToVolpe	yes/no field indicating if eFile sent to Volpe	dbBoolean	1			1	No
tblCOC	NeedToSendTo	yes/no field indicating if eFile needs to be sent to Volpe	dbBoolean	1			1	No
tblCOC	RevisionYN	yes/no field indicating if file has been revised	dbBoolean	1			1	No
tblCOC	PostFlag	yes/no field indicating if file has been posted	dbBoolean	1			1	No
tblCOC	SenderAddress	Address of company/person sending samples	dbText	50			1	"60 Port
tblCOC	SenderCity	City of company/person sending samples	dbText	50			1	"Libby"
tblCOC	SenderState	State of company/person sending samples	dbText	50			1	"MT"
tblCOC	SenderZip	ZIP code of company/person sending samples	dbText	50			1	"59923"
tblCOC	ClearanceSampl		dbBoolean	1			1	False
tblCOC	ClearanceSam		dbInteger	2			1	
tblCOCDetail								

Table	Field	Description	Datatype	Length	Precision	Scale	Nulls	Default
tblCOCDetail	COCdetailID	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblCOCDetail	COCID	Chain-of-custody identification nmber	dbText	50			0	
tblCOCDetail	IndexID	Index Indentification number assigned to a sample	dbText	50			0	
tblCOCDetail	TurnAroundTim	Time within which samples should be analyzed and results reported	dbDecimal	16	18	2	0	
tblCOCDetail	TurnAroundTim	Units used to report turn around time	dbText	10			0	
tblCOCDetail	AnalysisID	Identification number used for analysis	dbLong	4			1	
tblCOCDetail	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblCOCDetail	Comment	Detail Comment associated with record	dbText	255			1	
tblCOCDetail	SuffixID	Suffix Identification assigned to sample	dbText	1			1	
tblDataTransferStatus								
tblDataTransferStatus	ForeignID		dbLong	4			1	
tblDataTransferStatus	Reference		dbText	25			1	
tblDataTransferStatus	TransferTypeCo		dbText	10			1	
tblDataTransferStatus	TransferDate		dbDate	8			1	
tblDataTransferStatus	TransferPerson		dbLong	4			1	
tblDataTransferStatus	TransferID		dbText	50			1	
tblDataTransferStatus	DOE		dbDate	8			1	=Now()
tblDataTransferStatus	SeqNum		dbLong	4			1	
tblDataTransferStatus	Comment		dbText	255			1	
tblDirectory								
tblDirectory	DNIN	Directory Name Identification Number	dbLong	4			0	
tblDirectory	DPIN	Directory Property Identification Number	dbLong	4			1	
tblDirectory	Address	Directory name address	dbText	200			0	
tblDirectory	City	City where property is located directory entry	dbText	50			0	="Libby"
tblDirectory	State	State where property is located	dbText	50			0	="MT"
tblDirectory	ParcelCode	Parcel code for property	dbText	50			1	="59923"
tblDirectory	PropertyType	Indicates type of property (e.g., residiential, commercial, industrial)	dbText	50			0	
tblDirectory	BusinessName		dbText	100			1	
tblDirectory	BusinessDateU		dbDate	8			1	
tblDirectory	eFileToVotpe	Indicates if file has been sent	dbBoolean	1			1	No
tblDirectory	NeedToSendTo	Indicates if file needs to be sent	dbBoolean	1			1	No
tblDirectory	RevisionYN		dbBoolean	1			1	No
tblDirectory	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblDirectory	ImportDPIN		dbLong	4			1	
tblDirectorySample								
tblDirectorySample	DPIN	Directory Property Identification Number	dbLong	4			0	
tblDirectorySample	IndexID	Index Indentification number assigned to a sample	dbText	50			0	
tblDirectorySample	LocationID	Identification number assigned to location of sample	dbText	50			0	
tblDirectorySample	LocationSample	Identifies location sample group	dbText	50			0	
tblDirectorySample	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblDirectorySample	SeqNum		dbLong	4			1	
tbleFileStatus								
tbleFileStatus	COCID		dbText	50			1	
tbleFileStatus	FileExportFlag		dbBoolean	1			1	
tbleFileStatus	RevisionFile		dbBoolean	1			1	
tbleFileStatus	DOE		dbDate	8			1	=Now()

Table	Field	Description	Datatype	Length	Precision	Scale	Nulls	Default
tbleFileStatus	SeqNum		dbLong	4			1	
tblFDFRtemp								
tblFDFRtemp	IndexIDQCSam		dbText	50			1	
tblFDFRtemp	SampleType		dbText	50			1	
tblFDFRtemp	SampleComme		dbMemo	0			1	
tblFDFRtemp	IndexIDTarget		dbText	200			1	
tblLocation								
tblLocation	DPIN	Directory Property Identification Number	dbLong	4			0	
tblLocation	LocationID	Identification number assigned to location of sample	dbText	50			0	
tblLocation	DOE	The date the record is entered in database	dbDate	8			1	Now()
tblLocation	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblLocationTemp								
tblLocationTemp	LocationID		dbText	2			1	
tblPackage								
tblPackage	PackageID		dbLong	4			0	
tblPackage	PackageDesc		dbText	100			0	
tblPackage	PacakgeDOE		dbDate	8			0	=Now()
tblPackage	PackageSeqNu		dbLong	4			1	
tblPackagePropertyMailingAddress								
tblPackagePropertyMailingAddress	PPMAID		dbLong	4			0	
tblPackagePropertyMailingAddress	PMAddressID		dbLong	4			0	
tblPackagePropertyMailingAddress	PackageID		dbLong	4			0	
tblPackagePropertyMailingAddress	PPMADeliveryD		dbDate	8			0	
tblPackagePropertyMailingAddress	PackageDeliver		dbLong	4			0	
tblPackagePropertyMailingAddress	PPMADeliverySt		dbDate	8			0	
tblPackagePropertyMailingAddress	PackageDeliver		dbLong	4			0	
tblPackagePropertyMailingAddress	PPMADOE		dbDate	8			0	=Now()
tblPackagePropertyMailingAddress	PPMASeqNum		dbLong	4			1	
tblPersonalAir								
tblPersonalAir	IndexID	Index indentification number assigned to a sample	dbText	50			1	
tblPersonalAir	DNIN	Directory Name identification Number	dbLong	4			0	
tblPersonalAir	SampleTaskDes	Description of sample task	dbText	50			1	
tblPersonalAir	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblPersonalAir	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblPropertyAccess-V1Archive								
tblPropertyAccess-V1Archive	DPIN		dbLong	4			0	
tblPropertyAccess-V1Archive	StructureType		dbText	50			0	"Primary"
tblPropertyAccess-V1Archive	AccessAgreeme		dbBoolean	1			0	
tblPropertyAccess-V1Archive	DateNotified		dbDate	8			1	
tblPropertyAccess-V1Archive	AccessStatus		dbText	25			0	
tblPropertyAccess-V1Archive	AccessCommen		dbMemo	0			1	
tblPropertyAccess-V1Archive	DOE		dbDate	8			1	=Now()
tblPropertyAccess-V1Archive	SeqNum		dbLong	4			1	
tblPropertyConcern								
tblPropertyConcern	DPIN	Directory Property Identification Number	dbLong	4			0	
tblPropertyConcern	StructureType	Type of structure (primary/secondary)	dbText	50			0	"Primary"

Table	Field	Description	Datatype	Length	Precision	Scale	Nulls	Default
tblPropertyConcern	Concern	Concern voiced by property owner	dbText	50			0	
tblPropertyConcern	ConcernComme	Comments related to property concern	dbMemo	0			1	
tblPropertyConcern	ConcernDate	Date concern was voiced	dbDate	8			1	
tblPropertyConcern	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblPropertyConcern	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblPropertyInspection								
tblPropertyInspection	DPIN	Directory Property Identification Number	dbLong	4			0	
tblPropertyInspection	StructureType	Type of structure (primary/secondary)	dbText	50			0	"Primary"
tblPropertyInspection	InspectionIndoor	yes/no field indicating whether indoor inspection is complete	dbBoolean	1			0	
tblPropertyInspection	InspectionIndoor	Date indoor inspection was performed	dbDate	8			1	
tblPropertyInspection	InspectionIndoor	Comments relating to indoor inspection	dbMemo	0			1	
tblPropertyInspection	InspectionOutdo	yes/no field indicating whether outdoor inspection is complete	dbBoolean	1			0	
tblPropertyInspection	InspectionOutdo	Date outdoor inspection was performed	dbDate	8			1	
tblPropertyInspection	InspectionOutdo	Comments relating to outdoor inspection	dbMemo	0			1	
tblPropertyInspection	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblPropertyInspection	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblPropertyInterview								
tblPropertyInterview	DPIN	Directory Property Identification Number	dbLong	4			0	
tblPropertyInterview	StructureType	Type of structure (primary/secondary)	dbText	50			0	"Primary"
tblPropertyInterview	InterviewCompl	yes/no field indicating whether interview is complete	dbBoolean	1			0	
tblPropertyInterview	DateInterviewed	Date interview conducted	dbDate	8			1	
tblPropertyInterview	InterviewComm	Comments relating to interview with property owner	dbMemo	0			1	
tblPropertyInterview	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblPropertyInterview	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblPropertyMailingAddress								
tblPropertyMailingAddress	PMAddressID		dbLong	4			0	
tblPropertyMailingAddress	PMAddress		dbText	150			0	
tblPropertyMailingAddress	PMCity		dbText	50			0	"Libby"
tblPropertyMailingAddress	PMState		dbText	2			0	"MT"
tblPropertyMailingAddress	PMZipCode		dbText	10			1	
tblPropertyMailingAddress	PMActiveDateB		dbDate	8			0	
tblPropertyMailingAddress	PMActiveDateE		dbDate	8			1	
tblPropertyMailingAddress	PMAddressSour		dbLong	4			0	
tblPropertyMailingAddress	PMAddressDOE		dbDate	8			0	=Now()
tblPropertyMailingAddress	PMAddressSeq		dbLong	4			1	
tblPropertyMailingAddress	DPIN		dbLong	4			1	0
tblPropertyMisc								
tblPropertyMisc	DPIN	Directory Property Identification Number	dbLong	4			0	
tblPropertyMisc	StructureType	Type of structure (primary/secondary)	dbText	50			0	"Primary"
tblPropertyMisc	NoSoilCollected	yes/no field indicating whether soil was collected	dbBoolean	1			0	
tblPropertyMisc	NoSoilReason	Field indicating reason why soil was not collected	dbMemo	0			1	
tblPropertyMisc	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblPropertyMisc	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblPropertyPreDesignInspection								
tblPropertyPreDesignInspection	DPIN	Directory Property Identification Number	dbLong	4			0	
tblPropertyPreDesignInspection	StructureType	Type of structure (primary/secondary)	dbText	50			0	"Primary"

Table	Field	Description	Datatype	Length	Precision	Scale	Nulls	Default
tblPropertyPreDesignInspection	InspectionIndoor	yes/no field indicating whether indoor inspection is complete	dbBoolean	1			0	
tblPropertyPreDesignInspection	InspectionOutoo	yes/no field indicating whether outdoor inspection is complete	dbBoolean	1			0	
tblPropertyPreDesignInspection	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblPropertyPreDesignInspection	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblPropertyStatus								
tblPropertyStatus	DPIN	Directory Property Identification Number	dbLong	4			0	
tblPropertyStatus	PropertyStatusI	Unique ID from refPropertyStatus	dbLong	4			0	
tblPropertyStatus	DateNotified	Date property status is implemented (start)	dbDate	8			0	
tblPropertyStatus	EndDateNotified	Date property status is implemented (end)	dbDate	8			1	
tblPropertyStatus	PropertyStatusC	Comments related to property status	dbText	255			1	
tblPropertyStatus	eFileToVolpe	yes/no field indicating if eFile has been sent to Volpe	dbBoolean	1			1	No
tblPropertyStatus	NeedToSendTo	yes/no field indicating if eFile needs to be sent to Volpe	dbBoolean	1			1	
tblPropertyStatus	QCComplete	yes/no field indicating if quality control procedures have been completed	dbBoolean	1			1	No
tblPropertyStatus	RevisionCode	Indicates if the record is a revision	dbText	2			1	"N"
tblPropertyStatus	PropertyStatusO	Indicates if the status is an override for an existing status in libby2	dbBoolean	1			1	False
tblPropertyStatus	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblPropertyStatus	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblPumpTime								
tblPumpTime	IndexID	Index identification number for a sample	dbText	50			0	
tblPumpTime	PumpTimeStart	Time pump is started	dbDate	8			0	
tblPumpTime	PumpTimeEnd	Time pump is turned off	dbDate	8			0	
tblPumpTime	PumpStartFlow	Starting pump flow	dbDouble	8			1	
tblPumpTime	PumpStopFlow	Ending pump flow	dbDouble	8			1	
tblPumpTime	PumpFlowUnits	Units pump flow is recorded in	dbText	10			1	"L/min"
tblPumpTime	PumpTimeCom	Comments regarding pump operation	dbMemo	0			1	
tblPumpTime	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblPumpTime	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblQCSampleXRef								
tblQCSampleXRef	IndexIDTarget	Index identification number which has a related quality control sample	dbText	50			0	
tblQCSampleXRef	IndexIDQCSam	Quality control sample index indetification number related to the target	dbText	50			0	
tblQCSampleXRef	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblQCSampleXRef	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblSample								
tblSample	IndexID	Index identification number for a sample	dbText	50			1	
tblSample	LocationDesc	Description of location	dbText	200			1	
tblSample	ChargeNumber	Charge number associated with Sample	dbText	50			1	
tblSample	FieldDataSheet	Number of field data sheet where sample information was recorded in the	dbText	50			1	
tblSample	COC	Chain-of-custody number	dbText	50			1	
tblSample	SampleType	Field QC Sample type	dbText	50			0	
tblSample	GrabComposite	Indicates whether sample is a grab or composite	dbText	2			1	
tblSample	SampleMedia	Media of sample collected	dbText	50			0	
tblSample	DateCollected	Date sample was collected	dbDate	8			0	
tblSample	TimeCollected	Time sample was collected	dbDate	8			1	
tblSample	SampleTeam	Name of team collecting samples	dbText	50			1	
tblSample	SampleArea	Area measurement of where sample was collected	dbDecimal	16	10	2	1	
tblSample	SampleAreaUnit	Area measurement units	dbText	10			1	

Table	Field	Description	Datatype	Length	Precision	Scale	Nulls	Default
tblSample	FilterPoreSize	Pore size of filter used to collect sample	dbDecimal	16	18	4	1	
tblSample	GPSStatusID		dbText	50			1	
tblSample	GPSFile		dbText	100			1	
tblSample	ArchiveFlag	yes/no field indicating if sample is archive	dbText	1			1	"N"
tblSample	SampleVoid	yes/no field indicating whether a sample is void	dbBoolean	1			1	
tblSample	SampleComme	Comments related to samples collected	dbMemo	0			1	
tblSample	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblSample	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblSampleCounterTEMP								
tblSampleCounterTEMP	COCDetailID		dbLong	4			1	
tblSampleQC								
tblSampleQC	IndexID	Index identification number	dbText	50			1	
tblSampleQC	SampleQCdYN	yes/no field indicating whether sample has been through the quality control	dbBoolean	1			1	
tblSampleQC	SampleQCDate	Date sample went through the quality control process	dbDate	8			1	
tblSampleQC	SampleQCCom	Comments related to the sample quality control process	dbText	255			1	
tblSampleQC	UserID	Identification number for user	dbLong	4			1	
tblSampleQC	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	
tblSampleQC	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblSampleStatus								
tblSampleStatus	IndexID		dbText	50			0	
tblSampleStatus	SampleStatus		dbText	50			0	
tblSampleStatus	UpdatedBy		dbLong	4			0	
tblSampleStatus	SampleStatusD		dbDate	8			0	
tblSampleStatus	SampleStatusC		dbMemo	0			1	
tblSampleStatus	SeqNum		dbLong	4			1	
tblSampleStatus	DOE		dbDate	8			1	=Now()
tblSampleVer2TEMP								
tblSampleVer2TEMP	IndexID		dbText	50			1	
tblSampleVer2TEMP	LocationID		dbText	50			1	
tblSampleVer2TEMP	DPIN		dbLong	4			1	
tblVermStatus								
tblVermStatus	DPIN	Directory Property Identification Number	dbLong	4			0	
tblVermStatus	StructureType	Type of structure (primary/secondary)	dbText	50			0	"Primary"
tblVermStatus	VermPresent	Indicates if vermiculite is present	dbText	50			0	
tblVermStatus	VermLocation	Location where vermiculite is observed	dbText	50			1	
tblVermStatus	VermInOut	Indicates if vermiculite is indoors or outdoors	dbText	50			0	
tblVermStatus	VermComment	Comments	dbMemo	0			1	
tblVermStatus	DOE	The date the record is entered in database	dbDate	8			1	=Now()
tblVermStatus	SeqNum	Arbitrary unique sequential number used to identify a record	dbLong	4			1	

Libby Asbestos Project
Project-specific Standard Operating Procedure
Confirmation Soil Sample Collection

SOP No.: CDM-LIBBY-13, Revision 0
Project: Libby Asbestos Project
Task Order Number: 2616.012
Client: U.S. DOT Volpe Center
Approvals: M. Raney (Volpe Center) and P. Peronard (EPA) as part of the Response Action Sampling and Analysis Plan, Revision 1, dated April 9, 2008

1.0 Objective

The objective of this standard operating procedure (SOP) is to provide a consistent method for collecting soil samples to support investigations and response actions at residential, commercial, and industrial properties within the Libby Asbestos Superfund Site. Specifically, this SOP describes the equipment and procedures needed to collect 30-point composite confirmation soil samples and estimate visible vermiculite content in soil. Modifications to this SOP may be detailed in governing documents referencing this SOP, such as the Response Action Sampling and Analysis Plan (SAP) (CDM 2008), or in the site-specific removal work plan. The Volpe task order manager and/or EPA team leader (or their designate) must approve major changes to the procedures outlined in this document prior to initiating the sampling activity.

2.0 Background

2.1 Definitions

Composite Sampling - A sample in which multiple sample points are compiled together and submitted for analysis as a single sample.

Confirmation soil sample – For the purpose of this SOP, a confirmation soil sample is a sample intended to provide data of sufficient quality to meet the data quality objectives defined in the governing document. It is intended for confirmation analytical data after visual inspection.

Libby Asbestos Superfund Site - All buildings and land within the boundaries of each operable unit (OU) of the site as illustrated on the most recent version of the OU boundary map.

Site-specific removal work plan - The document that spells out the detailed property-specific removal activities to be performed. Site-specific removal work plans will clearly indicate specific requirements for the implementation of this SOP.

Sub-sample - The portion of the composite sample collected at a discrete location within a specified sample area. The dimension of a sub-sample point is approximately 2 inches in diameter and 2 inches deep.

2.2 Discussion

Composite sampling involves soil collection from multiple sub-sample locations within a specified area. Confirmation soil sampling will consist of collecting one 30-point composite sample from a discrete excavated area or areas as detailed in the site-specific removal work plan. The 30 sub-samples will be of approximately equal volume for a final sample volume between 2,000 and 2,500 grams (approximately one third of a gallon-sized zip-top plastic bag).

As each sub-sample is collected, the soil will be visually inspected for vermiculite. The location and semi-quantitative estimates of vermiculite will be recorded on a copy of the site-specific removal work plan as described in Section 5 below.

3.0 Responsibilities

Successful execution of this SOP requires a clear hierarchy of assigned roles with different sets of responsibilities associated with each role. All staff with responsibility for the collection of confirmation soil samples is responsible for understanding and implementing the requirements contained herein, as well as additional requirements stated in the governing document.

Task Leader (TL) or Field Team Leader (FTL) - The TL (e.g., construction manager) or FTL is responsible for overseeing sample collection processes as described in this SOP. The TL or FTL is also responsible for checking all work performed and verifying that the work satisfies the objectives of the data collection effort as specified in the governing document. The TL or FTL will communicate with the field team members regarding specific collection objectives and anticipated situations that require deviation from this SOP. It is also the responsibility of the TL or FTL to communicate the need for any deviations from the SOP with the appropriate EPA and Volpe Center personnel, and document the deviation using a Libby Asbestos Project Field Modification Form provided in the governing document.

Field team members - Field team members (e.g., sampling technicians, construction oversight staff) performing soil sampling are responsible for adhering to the procedures contained in this SOP. The field team members should have limited discretion with regard to collection procedures but should exercise judgment regarding the exact location of sample points within the specified sampling area.

4.0 Required Equipment

- Measuring tape or wheel – Used to estimate the square footage of each sampling area.
- Trowel (metal scoop) or push probe - For collecting surface soil samples.
- Disposable gloves (powderless plastic, latex, or nitrile) - For personal protection and to prevent cross-contamination of samples.

- Sample container - Gallon-sized zip-top plastic bags (2 per sample).
- Field clothing and personal protective equipment (PPE) - As specified in the current version of the site health and safety plan (HASP).
- Field sprayers – Used to suppress dust during sample collection and to decontaminate nondisposable sampling equipment between samples.
- Deionized (DI) water - Used in field sprayers to suppress dust and to clean and decontaminate sampling equipment.
- Plastic bristle brush - Used to clean and decontaminate sampling equipment.
- Wipes (disposable, paper) - Used to clean and decontaminate sampling equipment.
- Alconox – Used to clean and decontaminate sampling equipment weekly.
- 6-mil poly bag – Used to store and dispose of investigation-derived waste (IDW) or to store cleaned and dried equipment.
- Trash bag - Used to store and dispose of general trash.
- Field logbook/hand-held personal digital assistant (PDA) - Used to record progress of sampling efforts and record any problems and field observations.
- Field sample data sheets (FSDSs) – Used to record specific details of the sample collected.
- Copy of site-specific removal work plan – Used to record confirmation soil sample locations and demarcate areas where visible vermiculite remains at depth after excavation.
- Pin flags – Used to temporarily mark composite sub-sample locations within a sample area. At least two different colored pin flags are required.
- Permanent marking pen - Used to complete field documentation (e.g., logbooks, FSDSs), label sample containers, and to edit copies of the site-specific removal work plan.
- Sample Identification (ID) Labels (i.e., Index IDs) – Pre-printed stickers used on field documentation (e.g., FSDSs) and to label sample containers.
- Cooler or other rigid container - Used to store samples while in the field. Note that removal activity confirmation soil samples do not require any preservatives (e.g., ice).
- Custody Seals - For ensuring integrity of samples while in the field and during handling and shipping.

5.0 Procedures

5.1 Pre-sampling

Proper planning and coordination with the sample coordination team and removal contractor is essential to ensure confirmation samples are collected, processed, and analyzed in a timely manner to avoid delaying cleanup progress and any residential relocation. The reader is referred to the site-specific removal work plans for details regarding horizontal and vertical excavation limits, minimum or maximum square footage restrictions for confirmation soil sampling, and possible deviations to this SOP.

Confirmation samples will be collected once a specified area has undergone soil removal by excavation, digging, or other means and the field team member has deemed the excavated surface is ready for confirmation sampling in accordance with the site-specific removal work plan (i.e., soil has been excavated, at a minimum, to the pre-determined depth for that area).

5.2 Confirmation Soil Sample Collection

The procedures detailed below should be followed for the collection of confirmation soil samples:

1. Don the appropriate PPE as specified in the governing health and safety plan (HASP). Disposable gloves should be replaced or thoroughly decontaminated between each sample.

2. Identify excavated areas to be sampled as described in Section 5. Although the soil should be moist from engineering controls employed during excavation activities, the field team may use a sprayer to wet each sub-sample location prior to collection to reduce dust generation during sampling.

3. Collect horizontal measurements using a measuring tape, wheel, or other acceptable measuring methods to approximate the square footage of the sample area on a copy of the site-specific removal work plan.

4. Select 30 sub-sample locations evenly distributed within the excavated area, equidistant from each other. These 30 sub-sample locations will comprise the 30-point composite confirmation sample for the excavated area. All composite sub-samples will originate from the same area or areas being sampled as one unit.

5. Using the trowel or push probe, excavate a hole in the soil approximately 2 inches in diameter and 2 inches deep. As each sub-sample is collected, inspect the soil visually for vermiculite. Assign each sub-sample a semi-quantitative estimate of visible vermiculite content using a 4-point scale: none (blank), low (L), intermediate (M), or high (H). Photographs illustrating these quantities are attached to this SOP as Attachment 1. Additionally, jars of vermiculite-containing soils representing these four quantities will be available for training and reference.

6. Temporarily mark each sub-sample location with the appropriately-colored pin flag to indicate vermiculite for documentation purposes.

7. For sub-sampling locations where vermiculite is observed, record the estimate (e.g., L, M, or H) on a copy of the site-specific removal work plan. Sub-sample locations where vermiculite is not observed will not be recorded on the copy of the site-specific removal work plan.

8. Once a semi-quantitative estimate of visible vermiculite is performed for the sub-sample, place the excavated material directly inside the gallon-sized zip-top plastic bag. Repeat this step for each subsequent sub-sample until 30 composite sub-samples have been collected. It should be noted that a semi-quantitative estimate of high visible vermiculite in the excavated surface may necessitate additional excavation (depending upon current EPA cleanup criteria). In these cases, "high" concentrations would not be recorded on the copy of the site-specific removal work plan as all soil containing high concentrations of visible vermiculite would require excavation. Refer to the site-specific removal work plan for guidance on additional excavation.

9. After placing the material inside the bag, thoroughly homogenize the sample to the extent possible. The sample bag should be approximately one-third full (approximately 2,000 to 2,500 grams of material).

10. Affix the sample Index ID label to the inside of the bag and write the Index ID number on the outside of the bag, or affix an additional label to the outside of the bag using clear packing tape. Sample Index ID numbers will be assigned based on the current version of the RAWP or site-specific removal work plan, as applicable. Double-bag the sample and repeat the labeling process for the outer bag.

11. Decontaminate equipment between composite samples as described in Section 5.3. Decontamination is not required between sub-samples.

12. Repeat steps outlined above until all samples from excavated areas have been collected.

5.3 Equipment Decontamination and Site Cleanup

All sampling equipment must be decontaminated prior to and following use. Specific instructions for sample equipment decontamination are included in the governing document. In general, the procedure to decontaminate all soil sampling equipment is outlined below:

1. Remove all visible soil with DI water and/or plastic brush

2. Use DI water and plastic brush to wash each piece of equipment

3. Remove excess water present on the equipment by shaking

4. Use a paper towel to dry each piece of equipment

5. Store dried equipment in a one-gallon zip-top bag and/or 6-mil poly bag as appropriate

6. Dispose of spent wipes, gloves, aluminum foil, and PPE properly as IDW, as specified in the governing document.

7. Rinse water and any excess soil volume may be returned to the corresponding sampled area.

Special notes: Once a week, all soil sampling equipment will be cleaning using Alconox and DI water. Soil plugs or divots resulting from soil sampling do not need to be re-filled as excavated areas are generally backfilled during restoration activities.

5.4 Sample Custody

Sample custody will be conducted in accordance with procedures stated in the governing document.

6.0 Documentation

A field logbook/PDA will be maintained by each field team member collecting confirmation soil samples, as prescribed in the governing document.

7.0 Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) for activities described in this SOP will be attained through a variety of processes, including those discussed below. Additional QA/QC requirements, such as audits or field assessments, will be addressed in the governing document.

7.1 Training

Every effort will be made to ensure consistency in evaluating the quantity of vermiculite in soil. Consistency will be achieved to the extent possible through proper training, providing specimen examples (e.g., jars and photographs of low, intermediate, and high quantities of vermiculite), using designated field staff, and providing FTL oversight. Any deficiencies or inconsistencies in implementing this project-specific SOP noted by the FTL will require re-training of the field team. Figures illustrating none, low, intermediate, and high quantities of vermiculite are attached to this SOP for reference (Figure 1).

7.2 Field Quality Control Samples

Quality control samples may include field duplicates for confirmation soil samples. Confirmation soil field duplicate samples will be collected at the rate specified in the governing document. If collected, field duplicate samples will be collected as samples co-located in the same area as the parent sample. The duplicate will be collected using the same number of sub-samples as the parent sample but from different randomly-selected sub-sample locations. The inspection for visible vermiculite at each sub-sample location will

follow the same protocol as described above. Duplicate samples will be collected with separate sampling equipment or with the original sampling equipment from the parent sample after it has been properly decontaminated. For tracking purposes, the parent/duplicate sample relationship will be recorded in accordance with sample documentation requirements stated in the governing document, typically on the FSDS. These samples will be used to determine the variability of sample results in a given land use area. These samples will not be used to determine variability in sampling techniques.

8.0 References

CDM. 2008. Response Action Sampling and Analysis Plan, Libby Asbestos Project, Libby, Montana. April.

Attachment 1 – Libby Vermiculite Standards

Figure 1: Low Visible Vermiculite – A maximum of a few flakes of vermiculite observed within a given visual inspection point

Figure 2: Intermediate Visible Vermiculite – Vermiculite easily observed throughout visual inspection point, including the surface.

Figure 3: Intermediate Visible Vermiculite – Vermiculite easily observed throughout visual inspection point, including the surface.

Libby Asbestos Project
Project-specific Standard Operating Procedure
Stationary Air Sample Collection

SOP No.: CDM-LIBBY-14, Revision 0
Project: Libby Asbestos Project
Task Order Number: 2616.012
Client: U.S. DOT Volpe Center
Approvals: M. Raney (Volpe Center) and P. Peronard (EPA) as part of the Response Action Sampling and Analysis Plan, Revision 1, dated April 9, 2008

1.0 Objective

The objective of this standard operating procedure (SOP) is to establish baseline requirements, procedures, and responsibilities for collecting stationary air samples to support investigations and response actions at residential, commercial, and industrial properties within the Libby Asbestos Superfund Site (site). Modifications to this SOP may be detailed in governing documents referencing this SOP, such as the Response Action Sampling and Analysis Plan (SAP) (CDM 2008). The Volpe task order manager and/or EPA team leader (or their designate) must approve major changes to the procedures outlined in this document prior to initiating the sampling activity.

2.0 Background

2.1 Definitions

Stationary air sample – For the purpose of this SOP, a stationary air sample is a sample intended to provide data of sufficient quality to meet the data quality objectives defined in the governing document.

Libby Asbestos Superfund Site (site) - All buildings and land within the boundaries of each operable unit (OU) of the site as illustrated on the most recent version of the OU boundary map.

2.2 Discussion

Stationary air sampling at the site generally consists of using sampling pumps to draw air over a sample filter for a pre-determined period in order to measure airborne quantities of Libby amphibole (LA) asbestos.

Stationary air sample data serves many purposes at the site. Stationary air samples may be investigatory in nature, be used to determine compliance with Occupational Safety and Health Administration requirements, or measure attainment of site-specific action levels established by EPA to evaluate remedial actions.

3.0 Responsibilities

Successful execution of this SOP requires a clear hierarchy of assigned roles with different sets of responsibilities associated with each role. All staff responsible for collecting stationary air samples will understand and implement the requirements contained herein, as well as any additional requirements stated in the governing document.

Task Leader (TL) or Field Team Leader (FTL) - The TL (e.g., construction manager) or FTL is responsible for overseeing sample collection processes as described in this SOP. The TL or FTL is also responsible for checking all work performed and verifying that the work satisfies the objectives of the data collection effort as specified in the governing document. The TL or FTL will communicate with the field team members regarding the specific collection objectives and anticipated situations that require deviation from this SOP. It is also the responsibility of the TL or FTL to communicate the need for any deviations from the SOP with the appropriate EPA and Volpe Center personnel, and document the deviation using a Libby Asbestos Project Field Modification Form provided in the governing document.

Field Team Members – Field team members (e.g., construction oversight staff, sampling technicians, etc.) performing response action stationary air sampling are responsible for adhering to the procedures contained in this SOP. The field team members should have limited discretion with regard to collection procedures but should exercise judgment regarding the exact location of sample locations within the specified sampling area. Field team members are also responsible for communicating any consistent problems (e.g., equipment failure during cold weather conditions) with sample collection to the TL or FTL for the purpose of troubleshooting and information sharing with other field team members.

4.0 Required Equipment

- Sampling pump – Low-volume battery powered, such as an SKC Airchek Sampler Model 224-PCXR4, high-volume direct current Gast 1532 rotary vane pump, or equivalent used for collecting air samples.

- Phase contrast microscopy (PCM) sample cassettes - commercially available 25-millimeter (mm), three-piece cassette with a 50mm electronically conductive extension cowl loaded with a 0.8 micron (μ) mixed cellulose ester (MCE) filter.

- Sampling stands – telescoping tripods designed specifically to hold sample cassettes at the desired height will be used to support the sample cassette in order to isolate the sample from the vibrations of the sampling pump.

- Inert tubing – Tygon tubing used in the sampling train to connect the outflow end of the sample cassette to the sampling pump. Tubing has a 3/16" inner diameter and 5/16" outer diameter.

- Rotameter – A rotameter calibrated such that the operator can measure flow rates to ±5% accuracy at the expected sampling flow rate. A rotameter is used as a secondary calibration device.

- Drycal – Drycal will be used to calibrate the rotameter on a quarterly basis. A Drycal is used as a primary calibration device.

- Stationary air field sample data sheets (FSDSs) – Specific data related to the collection of each sample will be recorded on a FSDS. This sheet will contain all relevant information regarding equipment used, flow rates, and collection times. An example copy of the stationary air FSDS will be included as an appendices in the governing document.

- Permanent marking pen - Used to complete field documentation (e.g., logbooks, FSDSs) and label sample cassettes and containers.

- Sample Identification (ID) Labels (i.e., Index IDs) – Pre-printed stickers used on field documentation (e.g., FSDSs) and to label sample cassettes and containers.

- Half-quart sized plastic zip-top bags – Used to store individual air sample cassettes to ensure sample integrity and prevent cross contamination.

- Cooler or other rigid container - Used to store bagged samples while in the field. Note that removal activity stationary air samples do not require any preservatives (e.g., ice).

- Custody Seals - For ensuring integrity of samples while in the field and during handling and shipping.

- Small standard screwdriver

- Logbook/hand-held personal digital assistant (PDA)

5.0 Procedures

Prior to conducting work at any Libby worksite, health and safety procedures, as specified in the governing health and safety plan will be reviewed and the appropriate personal protective equipment (PPE) donned.

5.1 Calibration of Rotameter with an Electronic Calibrator

Rotameters used for pump calibration are calibrated to a primary flow standard on a quarterly basis. The primary flow standard in use at the site is a Dry-Cal (DC)-Lite primary flow meter manufactured by Bios International Corporation. Procedures for rotameter calibration with the DC-Lite flow meter are as follows:

1. Obtain the actual temperature and pressure in Libby, Montana from the local National Oceanic and Atmospheric Administration (NOAA) weather station.

Record actual temperature and pressure in the fields provided on the Precision Rotameter Calibration Data Sheet (Attachment 1).

2. Set up the calibration train as shown in EPA SOP #2015 (EPA 1994), Figure 4, with the sampling pump, rotameter, and primary flow meter (Attachment 2).

3. The rotameter will be held perpendicular to the plane of the table no greater than 6° off of vertical.

4. Turn the DC-Lite and sampling pump on.

5. Turn the flow adjust screw or knob on the pump until the desired flow rate is attained.

6. Calibrate rotameter to desired ball reading, as read from the middle of the flow ball, with a sampling pump and sample cassette in-line. The cassette used for calibration must be the same type and from the same lot of sample cassettes that will be used for sampling. Record value in the ball reading column on the rotameter calibration data sheet.

7. Check adjusted flow rate of sample pump to the DC-Lite flow calibrator primary flow standard. Ten repetitive flow measurements will be averaged and that result recorded in the flow rate column for the selected interval.

8. Repeat this process at 10 intervals over the range of the precision rotameter.

9. Input data into rotameter calculation sheet to generate the corrected flow rate.

5.2 Flow Rates and Sample Volume

Response action stationary air samples will be collected using flow rates ranging between 1.0 and 10.0 liters per minute (L/min), with a minimum total sample volume of 1,200 liters. Flow rates will be set at the discretion of the field team member in order to capture, at a minimum, 80 percent (%) of the workday. The sampling pump will provide a non-fluctuating air flow through the filter, and will maintain the initial volume flow rate to within ±10% throughout the sampling period. If at any time the measurement indicates that the flow rate has increased or decreased by more than 10% of the set flow rate, sample collection will cease and the sample will be voided.

In no case will a sample be collected at a flow rate lower than 1.0 L/min, since the linear flow velocity would fall below 4 centimeters per second (cm/sec), which is the minimum velocity specified by the International Organization for Standardization (ISO) method 10312 (ISO 1995) that is used for Libby project air samples.

As samples are initially collected during the sampling event and analyzed, flow rates and sample times may be adjusted to ensure the loading on the sample filter facilitates reaching the required sensitivity goals (i.e., to prevent filter overloading). Filter loading is discussed in more detail in Section 5.4.2 of this SOP.

5.3 Calibration of Sampling Pump with a Rotameter

Each sampling pump will be calibrated before and after each sampling event with a primary or secondary calibration device as described below. This is to ensure that each sampling pump is operating to project requirements as stated in Section 5.2.

The procedures used for sampling pump calibration are as follows:

1. Set up the calibration chain as shown in EPA SOP #2015 (EPA 1994), Figure 5 (Attachment 3) using a rotameter, sampling pump, and a representative sample cassette. The sample cassette to be used for sampling is installed between the pump and the calibrator.

2. To set up the calibration train, attach one end of tubing to the sample cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the sample cassette cap to the rotameter.

3. The flow meter should be held within 6 degrees (°) of vertical.

4. Turn the sampling pump on.

5. Turn the flow adjust screw or knob on the manifold regulating air flow to the samples until the middle of the float ball on the rotameter is lined up with the pre-calibrated flow rate value.

Note: A sampling pump, such as a Gast high volume pump, equipped with more than one manifold may be used to collect more than one sample at a time. In the case two samples will be collected from one pump, calibration must be checked after each alteration of the flow regulators. For example: Turn the knob on (manifold A) until the middle of the float ball on the rotameter is at the desired flow rate value. Turn the knob on (Manifold B) until the middle of the float ball on the rotameter is at the desired flow rate value. Verify the calibration of (manifold A), adjust as required. This process must be repeated until both (manifold A) and (manifold B) are at the desired flow rate.

Each rotameter used for field calibration will be transported to and from each sampling location in a sealed zip-top plastic bag.

5.4 Stationary Air Sample Collection

5.4.1 Selection of Stationary Air Sampling Locations

If not specifically discussed in the governing document, the location of each stationary air sample will be determined by field personnel based on site-specific conditions (e.g., placement of the removal contractor's equipment, soil excavation boundaries, etc).

5.4.2 Sample Collection Protocol

Each stationary air sample will be collected according to the following procedures:

1. Place an Index ID label on the sample cassette indicating a unique sampling ID number. Place the corresponding Index ID number on the FSDS.

2. Determine proper sample location.

3. Set up the sampling train: attach the air intake hose to the sample cassette base. Follow calibration procedures listed in Section 5.3. The sample cassette will be positioned such that it is held facing downwards at an angle equal to or less than 45° from horizontal. Set the sample cassette to a height of approximately 5 feet above ground surface. The preferred method is to use a telescoping sample stand or suitable means to place sample at such a desired height. Remove the sample cassette cap and turn the sampling pump on.

4. Record all pertinent information on the FSDS.

5. Check the sampling pump at a minimum of every 4 hours. If the sample filter darkens in appearance or if loose dust is observed inside the cassette, the sample period will be terminated and the remaining steps below followed to complete collection of the sample. The loading observations will be noted on the FSDS in the comment section.

6. At the end of the sampling period, orient the sample cassette to face upwards. Do not remove the sampling cassette from the sampling train. Turn the pump off.

7. Collect the post-sampling flow rate with one of the calibration devices. The same sample cassette will be used to determine the post-sampling flow rate.

8. Record the post-sampling flow rate.

9. Record the stop date and time.

10. Remove the tubing from the sample cassette. Still holding the sample cassette upright, replace the inlet plug on the sample cassette cap and the outlet plug on the sample cassette base. Do not put sample cassettes in shirt or coat pockets as the filter can pick up fibers.

11. Wrap a sample custody seal around both ends of the sample cassette.

12. Place each sample cassette in a half-quart sized plastic zip-top sample bag. Each bag should be marked with indelible ink indicating the sample Index ID number.

5.4.3 Pump Failure Procedures

If a sampling pump faults prior to the total desired run time, the following procedures will be used:

1. Record the time of the observed pump fault in the comments section of the FSDS.

2. If using a SKC low-volume pump, record the total sample time (in minutes) from the pump counter and note accordingly in the comments section of the FSDS sheet, then add total minutes collected to the start time and document the actual stop time in the stop time section of the FSDS.

3. If no minutes appear on the pump counter, void the sample and recollect as directed by the site health and safety officer.

4. If time allows, change out the pump and restart sampling. Turn the sampling pump back on and calibrate as required (Section 5.1) until desired sample volume requirements are met.

5.5 Equipment Decontamination

Non-disposable air sampling equipment will be decontaminated according to instructions provided in the governing document. In general, sampling pumps and tubing will be wet-wiped prior to and following sample collection.

5.6 Sample Custody

Custody requirements for stationary air samples will be specified in the governing document.

6.0 Documentation

In addition to FSDSs, a field logbook will be maintained by each field team member collecting stationary air samples, as prescribed in the governing document.

7.0 Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) for activities described in this SOP will be attained through a variety of processes, including, but not limited to, the items discussed below. Additional QA/QC requirements, such as audits or field assessments, will be addressed in the governing document.

7.1 Training

Every effort will be made to ensure consistency in collecting stationary air samples in support of Libby response actions. Consistency will be achieved to the extent possible through proper training, using designated field staff, and providing FTL oversight. Any deficiencies or inconsistencies in implementing this project-specific SOP noted by the FTL will require re-training of the field team.

7.2 Equipment Maintenance

The manufacturer's instructions regarding operating procedures and maintenance will be reviewed prior to equipment use. Equipment and instrumentation will be utilized in accordance with manufactures instructions.

7.3 Field Quality Control Samples

The field quality control (QC) samples for response action stationary air sampling at the site typically consist of lot blanks and field blanks; however, the field team is referred to the governing document for field quality control sample collection requirements.

8.0 References

CDM. 2008a. Response Action Work Plan, Libby Asbestos Project, Libby, Montana. February.

CDM. 2008b. Response Action Sampling and Analysis Plan, Libby Asbestos Project, Libby, Montana. April.

EPA. 1994. Asbestos Sampling, Standard Operating Procedure #2015, Revision 0.0. November 17.

International Organization of Standardization. 1995. Ambient Air - Determination of Asbestos Fibers - Direct Transfer Transmission Electron Microscopy Method. ISO 10312:1995(E).

Attachment 1

Libby Asbestos Project
Precision Rotameter Calibration Data Sheet

Task Order: _____
Calibration Date: _____ **Calibrated By:** _____
Odometer ID: _____ **Primary Standard ID:** _____
Actual Temp (°F): _____ **Actual Pressure (in. Hg):** _____
°F=Degrees Fahrenheit
in. Hg= inches mercury

	Ball Reading =Y (mid-ball)	Flow rate = X_1 (L/min)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Rotameter Calibration Procedure.

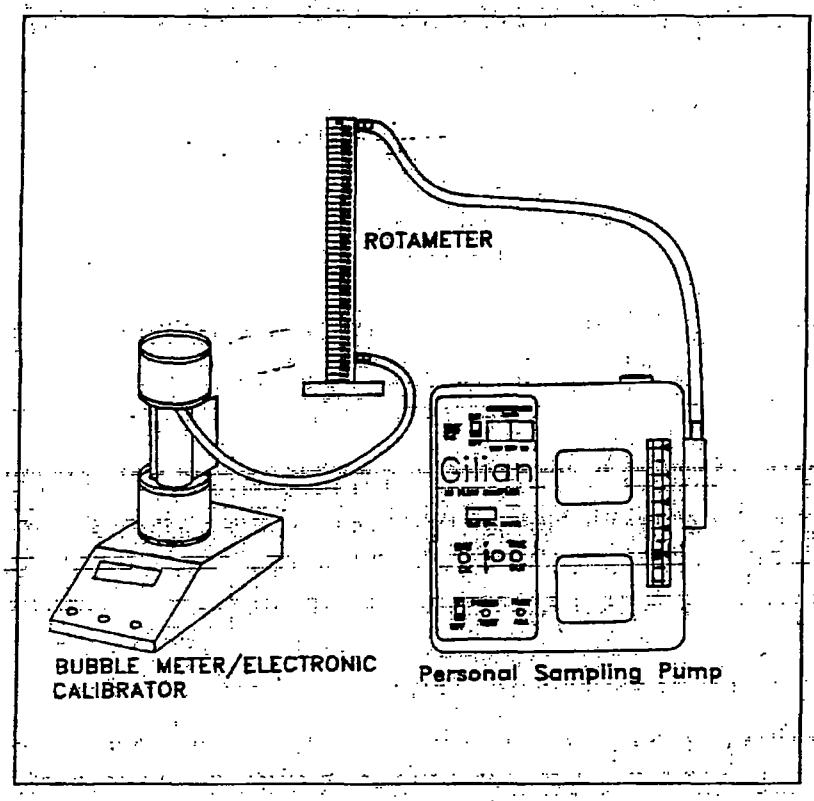
1. *Obtain the actual temperature and actual pressure in Libby, MT from the project weather* station. Record the actual temp. and actual pressure in the fields provided above.
2. Calibrated rotameter to desired ball reading with a sampling pump and cassette in-line. Cassette must be the same type and from the same lot of cassette that will be used for sampling. Record value in the Ball Reading column.
3. Check adjusted flowrate of sample pump to the Dry Cal flow calibrator primary flow standard. 10 repetitive flow measurements will be averaged and that result recorded in the Flow rate column for the selected interval.
4. Repeat this process at 10 intervals over the range of the precision rotameter. Input data into rotameter calculation sheet to generate the corrected flow rate

Attachment 2

APPENDIX B (Cont'd)

Figures

FIGURE 4. Calibrating a Rotameter with a Bubble Meter

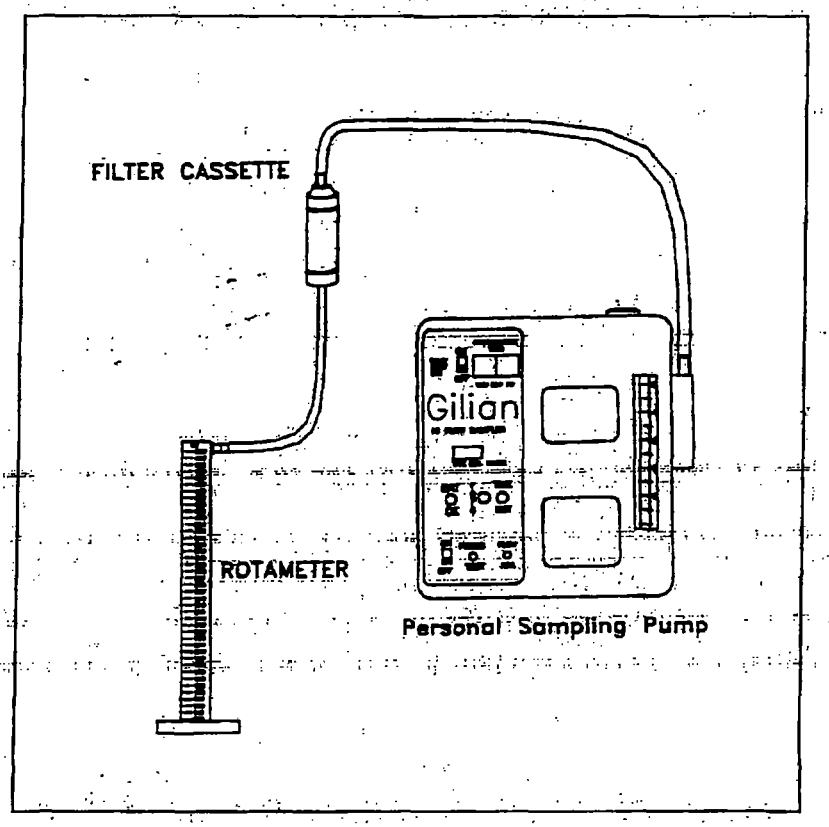


Attachment 3

APPENDIX B (Cont'd)

Figures

FIGURE 5. Calibrating a Sampling Pump with a Rotameter



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APPENDIX B
Field Planning Meeting Form

DCN: _____

Field Planning Meeting Form

Instructions: Prior to the field planning meeting (FPM), this form must be reviewed and approved by the project QA Coordinator and H&S Coordinator. This completed form must be placed in the project file with a DCN.

Meeting Date/Time:

Conducted By:

Project Name:

Project No.:

Project Manager:

Field Team Leader/Site Manager:

Field Activity Dates/Schedule:

Type of Field Event (SI, RI/FS, etc.):

List of Documents to be discussed/present at the FPM (H&S Plan, SAP, QAPP, CDAP, etc.):

Attendees:

	Name (Printed)	Role	Affiliation	Signature
1		Field Team Leader		
2		QA Coordinator		
3		H&S Coordinator		
4		Sample Coordinator		
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Agenda: (Detail each item accordingly; attach additional sheets as needed.)

Project Objectives:

Field Measurements:

Type and Number of Samples Planned to be Collected (quantify all that apply):

Soil:	Dustfall:	Groundwater:
Sediment:	Personal Air:	Surface Water:
Microvacuum Dust:	Stationary Air:	Bulk Materials:
Other:		

Analytical Method(s):

QC Sample Type(s)/Number Required:

Equipment/Calibration Standards Needed:

Procedures to Follow (SOPs, etc.):

Training Requirements:

Other QA/QC Issues:

Health & Safety:

Health and Safety Action Levels:

Target Contaminants and Highest Levels Detected:

Personal Protective Equipment:

Other Health and Safety Issues:

Agenda Approvals:

QA Coordinator (Signature and Date): _____

Health and Safety Coordinator (Signature and Date): _____

CC: Project File
QA Coordinator
H&S Coordinator

APPENDIX C
Example Field Sample Data Sheets

Sheet No.: PA- **000000**

LIBBY FIELD SAMPLE DATA SHEET (FSDS) FOR PERSONAL AIR

Field Logbook No: _____ Page No: _____ Sampling Date: _____

Address: _____ Owner/Tenant: _____

Business Name: _____

Land Use: Residential School Commercial Mining Roadway Other ( )

Sampling Team: CDM Other _____ Names: _____

Person Sampled: _____ SSN: _____ Task: _____

Data Item	Cassette 1	Cassette 2	Cassette 3
Index ID			
Location ID			
Sample Group			
Location Description			
Category (circle)	FS FB-(field blank) LB-(lot blank)	FS FB-(field blank) LB-(lot blank)	FS FB-(field blank) LB-(lot blank)
Matrix Type (circle)	Indoor Outdoor	Indoor Outdoor	Indoor Outdoor
Filter Diameter (circle)	25mm 37mm	25mm 37mm	25mm 37mm
Pore Size (circle)	TEM- .45 PCM- 0.8	TEM- .45 PCM- 0.8	TEM- .45 PCM- 0.8
Flow Meter Type (circle)	Rotometer DryCal NA	Rotometer DryCal NA	Rotometer DryCal NA
Pump ID Number			
Flow Meter ID No.			
Start Date			
Start Time			
Start Flow (L/min)			
Stop Date			
Stop Time			
Stop Flow (L/min)			
Pump fault? (circle)	No Yes NA	No Yes NA	No Yes NA
MET Station onsite?	No Yes NA	No Yes NA	No Yes NA
Sample Type	TWA EXC NA	TWA EXC NA	TWA EXC NA
Field Comments Cassette Lot Number: _____	Archive Blank (circle): Yes No	Archive Blank (circle): Yes No	Archive Blank (circle): Yes No
Entered (LFO) _____	Volpe: Entered _____ Validated _____	Volpe: Entered _____ Validated _____	Volpe: Entered _____ Validated _____

For Field Team Completion (Provide Initials)	Completed by	QC by

vs 10507

Sheet No.: SA-**000000**

LIBBY FIELD SAMPLE DATA SHEET (FSDS) FOR STATIONARY AIR

Field Logbook No: _____ Page No: _____ Sampling Date: _____

Address: _____ Owner/Tenant: _____

Business Name: _____

Land Use: Residential School Commercial Mining Roadway Other ( )

Sampling Team: CDM Other _____ Names: _____

Data Item	Cassette 1	Cassette 2	Cassette 3
Index ID			
Location ID			
Sample Group			
Location Description			
Category (circle)	FS FB-(field blank) LB-(lot blank) DB-(prep-dry blank)	FS FB-(field blank) LB-(lot blank) DB-(prep-dry blank)	FS FB-(field blank) LB-(lot blank) DB-(prep-dry blank)
Matrix Type (circle)	Indoor Outdoor NA	Indoor Outdoor NA	Indoor Outdoor NA
Filter Diameter (circle)	25mm 37mm	25mm 37mm	25mm 37mm
Pore Size (circle)	TEM- .45 PCM- 0.8	TEM- .45 PCM- 0.8	TEM- .45 PCM- 0.8
GPS Status (circle)	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected- not required for sample	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected- not required for sample
GPS File (fill in or circle)	Filename:_____ NA	Filename:_____ NA	Filename:_____ NA
Flow Meter Type (circle)	Rotometer DryCal NA	Rotometer DryCal NA	Rotometer DryCal NA
Pump ID Number			
Flow Meter ID No.			
Start Date			
Start Time			
Start Flow (L/min)			
Stop Date			
Stop Time			
Stop Flow (L/min)			
Pump fault? (circle)	No Yes NA	No Yes NA	No Yes NA
MET Station onsite? (circle)	No Yes NA	No Yes NA	No Yes NA
Sample Type (circle)	Pre Post Clear 2nd Clear 3rd Clear NA	Pre Post Clear 2nd Clear 3rd Clear NA	Pre Post Clear 2nd Clear 3rd Clear NA
Field Comments Cassette Lot Number:_____	Archive Blank (circle): Yes No	Archive Blank (circle): Yes No	Archive Blank (circle): Yes No
Entered (LFO): ____	Volpe: Entered ____ Validated ____	Volpe: Entered ____ Validated ____	Volpe: Entered ____ Validated ____

For Field Team Completion (Provide Initials)	Completed by:	QC by:

vs 10507

Sheet No.: S- **000000**

LIBBY FIELD SAMPLE DATA SHEET (FSDS) FOR SOIL

Field Logbook No: _____ Page No: _____ Sampling Date: _____

Address: _____ Owner/Tenant: _____

Business Name: _____

Land Use: Residential School Commercial Mining Roadway Other ( )

Sampling Team: CDM Other _____ Names: _____

Data Item	Sample 1	Sample 2	Sample 3
Index ID			
Location ID			
Sample Group			
Location Description (circle)	Back yard Front yard Side yard Driveway Other _____	Back yard Front yard Side yard Driveway Other _____	Back yard Front yard Side yard Driveway Other _____
Category (circle)	FS *FD of* _____ EB LB	FS *FD of* _____ EB LB	FS *FD of* _____ EB LB
Matrix Type (Surface soil unless other wise noted)	Surface Soil Other _____	Surface Soil Other _____	Surface Soil Other _____
Type (circle)	Grab Comp. # subsamples _____	Grab Comp. # subsamples _____	Grab Comp. # subsamples _____
GPS Status (circle)	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample
GPS File (fill in or circle)	Filename:_____ NA	Filename:_____ NA	Filename:_____ NA
Sample Time			
Top Depth (inches below ground surface)			
Bottom Depth (inches below ground surface)			
Field Comments *Note if vermiculite is visible in sampled area*	BD-_____	BD-_____	BD-_____
Entered (LFO) _____	Volpe: Entered _____ Validated _____	Volpe: Entered _____ Validated _____	Volpe: Entered _____ Validated _____

For Field Team Completion (Provide Initials)	Completed by:	QC by:

vs 10507

APPENDIX D
Libby Asbestos Project Record of Modification Forms (Field and Laboratory)

Record of Modification

to the

Libby Sampling and Quality Assurance Project Plan

Field Activities

LFO-0000__

Instructions to Requester: **Fax to contacts at bottom of form for review and approval.**
File approved copy with Data Manager at the Libby Field Office (LFO).
Data Manager will maintain legible copies in a binder that can be accessed by LFO personnel.

Project QAPP (circle one): Phase I (approved 4/00) Phase II (approved 2/01)
Removal Action (approved 7/00) Contaminant Screening Study (approved 5/02)
Other (Title and approval date):_____

SOP (Number and Revision No.):_____

Requester: _____ Title: _____
Company: _____ Date: _____

Description of Modification (attach additional sheets if necessary; state section and page numbers of the SQAPP that are affected by the proposed modification):_____

Field logbook and page number where Modification is documented (or attach associated correspondence):

Potential Implications of Modification: _____

Duration of Modification (circle one):
Temporary Date(s):_____
Resident address(es): _____

- If appropriate, attach a list of all applicable Index Identification numbers.

Permanent (Proposed Text Modification Section) Effective Date:_____

Proposed Text Modifications in Associated Guidance Document (attach additional sheets if necessary):____

Data Quality Indicator (circle one) – Please reference definitions on reverse side for direction on selecting data quality indicators:

Not Applicable **Reject** **Low Bias** **Estimate** **High Bias** **No Bias**

Technical Review and Approval: _____ Date:_____
(Volpe Project Manager or designate)

EPA Review and Approval: _____ Date:_____
(USEPA RPM or designate)

DATA QUALITY INDICATOR DEFINITIONS

Reject - Samples associated with this modification form are not useable. The conditions outlined in the modification form adversely effect the associated sample to such a degree that the data are not reliable.

Low Bias - Samples associated with this modification form are useable, but results are likely to be biased low. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated low.

Estimate - Samples associated with this modification form are useable, but results should be considered approximations. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimates.

High Bias - Samples associated with this modification form are useable, but results are likely to be biased high. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated high.

No Bias - Samples associated with this modification form are useable as reported. The conditions outlined in the modification form suggest that associated sample data are reliable as reported.

Request for Modification
to
Laboratory Activities
LB-_____

Instructions to Requester: E-mail form to contacts at bottom of form for review and approval.
File approved copy with Data Manager (CDM). Data Manager distributes approved forms as follows:
All Labs Applicable forms – copies to: EPA, Volpe, CDM, All project labs
Individual Labs Applicable forms – copies to: EPA, Volpe, CDM, Initiating Lab

Method (circle one/those applicable): TEM-AHERA TEM-ISO 10312 PCM-NIOSH 7400 NIOSH 9002
EPA/600/R-93/116 ASTM D5755 EPA/540/2-90/005a SRC-LIBBY-03
Other:_____

Requester:_____ Title: _____
Company: _____ Date: _____

Description of Modification:

_____
_____

Reason for Modification:

_____
_____

Potential Implications of this Modification:

_____
_____

Laboratory Applicability (circle one): All Individual(s) _____

This laboratory modification is (circle one): **NEW** **APPENDS to** _____ **SUPERCEDES** _____

Duration of Modification (circle one):
Temporary Date(s): _____
Analytical Batch ID: _____
Temporary Modification Forms – Attach legible copies of approved form w/ all associated raw data packages

Permanent (Complete Proposed Modification Section) Effective Date: _____
Permanent Modification Forms – Maintain legible copies of approved form in a binder that can be accessed by analysts.

Data Quality Indicator (circle one) – Please reference definitions on reverse side for direction on selecting data quality indicators:

Not Applicable **Reject** **Low Bias** **Estimate** **High Bias** **No Bias**

Proposed Modification to Method (attach additional sheets if necessary; state section and page numbers of Method when applicable):

_____
_____

Technical Review: _____ Date: _____
(Laboratory Manager or designate)

Project Review and Approval: _____ Date: _____
(Volpe: Project Technical Lead or designate)

Approved By: _____ Date: _____
(USEPA: Project Chemist or designate)

DATA QUALITY INDICATOR DEFINITIONS

Reject - Samples associated with this modification form are not useable. The conditions outlined in the modification form adversely effect the associated sample to such a degree that the data are not reliable.

Low Bias - Samples associated with this modification form are useable, but results are likely to be biased low. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated low.

Estimate - Samples associated with this modification form are useable, but results should be considered approximations. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimates.

High Bias - Samples associated with this modification form are useable, but results are likely to be biased high. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated high.

No Bias - Samples associated with this modification form are useable as reported. The conditions outlined in the modification form suggest that associated sample data are reliable as reported.